Karen J. Tietze

CLINICAL SKILLS FOR PHARMACISTS

EDITION 3

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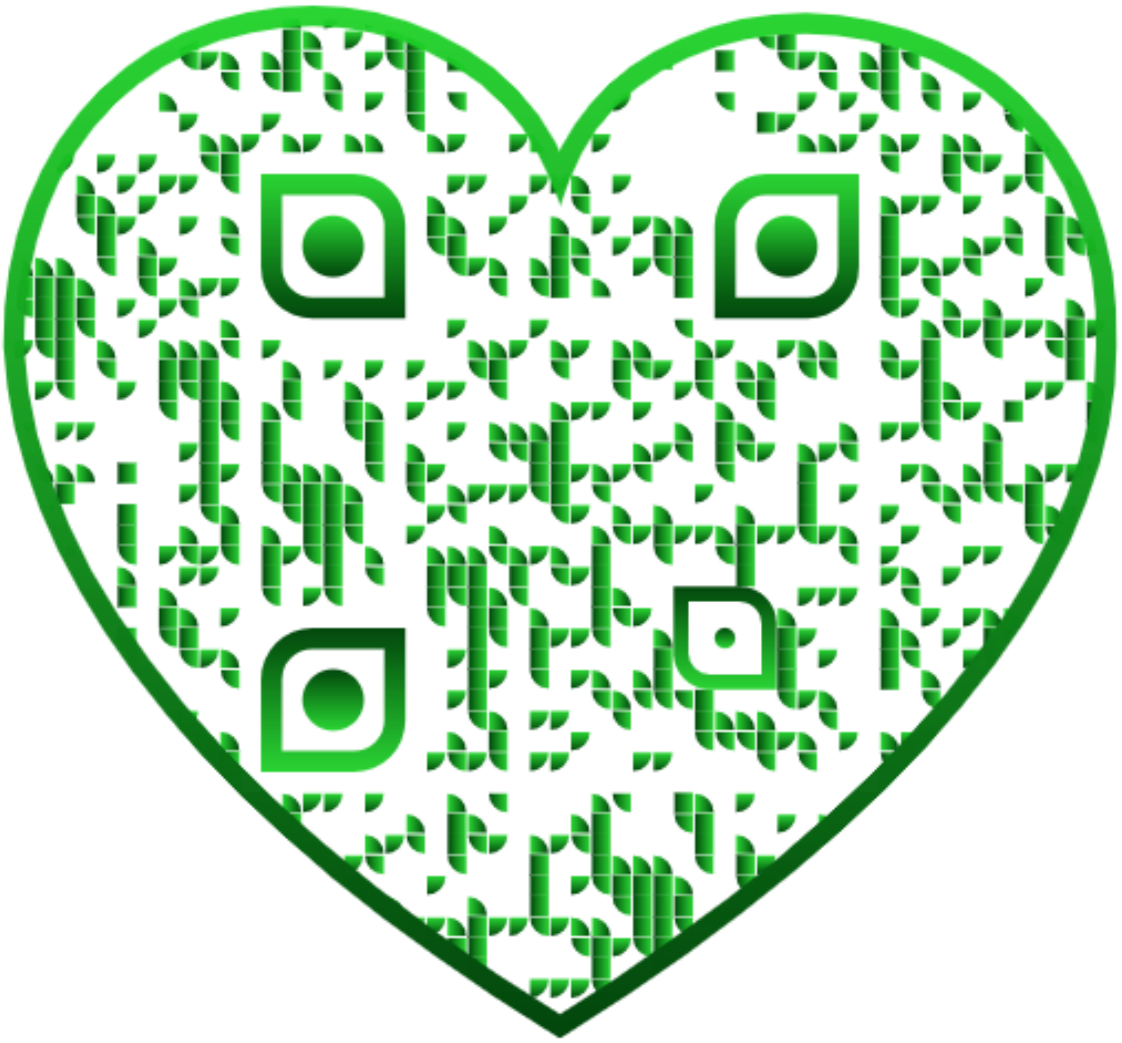

CLINICAL SKILLS FOR PHARMACISTS

A Patient-Focused Approach

EDITION 3

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To my students

Preface

In the preface to the first edition of *Clinical Skills for Pharmacists,* I described how the book was developed, the organization, structure, and format of the book, as well as my hopes for the book. I ended the preface by stating that the book was a work in progress and that all suggestions for improvement were welcome. Although I thought the book was unique, and hoped it would find a useful niche within the profession, I was unsure of its acceptance. I have been quite surprised by the overwhelmingly positive response the first two editions of the book have elicited. Although my students delight in pointing out the occasional typographical error or inconsistency, feedback regarding the style and content has been consistently positive. The book has found a niche as a unique compilation of skill-related topics, and is complementary to clerkship manuals and physical assessment, pharmacotherapeutics, and ethics textbooks.

The third edition has been completely updated. The book is now in color and in a larger format. More than 100 images (figures, photographs, illustrations), most in color, were added to this edition. A list of chapter acronyms was added to the book, for easy reference. Also new to the third edition are chapter-specific application exercises. Located at the end of each chapter, the application exercises are best completed in small groups, though they can be completed individually.

Approximately one-third of the book content is new. Basic clinical pharmacy skills remain the focus of the book, but the skills have been expanded to facilitate longitudinal development throughout the pharmacy curriculum. Chapter 1, *Introduction: The Practice of Clinical Pharmacy,* was updated to reflect the current state of pharmacy practice, including medication therapy management, medication reconciliation, and pharmacy-based immunization. Cultural diversity and telecommunication were added to Chapter 2, *Communication Skills for the Pharmacist.* The immunization history as a component of the medication history, examples illustrating each component of the medication history, and a medication history checklist were added to Chapter 3, *Taking Medication Histories.* Chapter 4, *Physical Assessment Skills,* was expanded and reorganized to provide more contextual context for pharmacists, including checklists for assessing skills performance. A new biomarker section was added to Chapter 5, *Review of Laboratory and Diagnostic Tests.* Examples illustrating each component of the structured patient case were added to Chapter 6, *The Patient Case Presentation.* More examples and guidance were added to Chapter 7, *Therapeutics Planning,* and Chapter 8, *Monitoring Drug Therapies.* Chapter 9, *Researching and Providing Drug Information,* was completely updated and example drug information questions, including answer, source, and comments were added. A discussion of contemporary pharmacy-related ethical issues, including conscientious objection, and issues related to confidentiality and research were added to Chapter 10, *Ethics in Pharmacy and Health Care.*

This book remains a work in progress. Comments and suggestions for improvement are always welcome.

Karen J. Tietze

Acknowledgments

It is impossible to individually thank all those who contributed to the development of this book. I hope that my global thanks reach everyone involved in the development and publication of this book. I thank all my students who continue to teach me how best to learn clinical pharmacy skills. I also thank my colleagues at the Philadelphia College of Pharmacy, University of the Sciences whose moral support during the developmental stages of the book and the writing of the second and third editions of the book was invaluable.

Special thanks to the following individuals who provided detailed reviews of one or more chapters when the first edition of the book was being developed: Jerry L. Bauman, Pharm.D.; Janice A. Gaska, Pharm.D.; Arthur I. Jacknowitz, Pharm.D.; Paul L. Ranelli, Ph.D.; and Timothy H. Self, Pharm.D.

I am especially indebted to Dr. Janice Gaska. Our original plan was to coauthor the book. We spent countless hours planning the book before she changed careers. The book reflects both of our philosophies and is much better than I could have created on my own.

No book can succeed without the resources and support of the publisher. I have been incredibly lucky to work with very talented editors from Elsevier, Inc. My editorial team for the first edition included Sandra Parker, Developmental Editor; Laura MacAdam, Developmental Editor; Jennifer Roche, Acquisitions Editor; and Jennifer Furey, Production Editor. Their guidance and enthusiasm were invaluable. The editors for the second edition, Kellie White, Editor, and Kim Fons, Senior Developmental Editor had a "can do" attitude and never-failing enthusiasm for the book that kept me motivated and on track with a very ambitious production timeline. For the third edition, I was very privileged to work once again with Kellie White, Executive Editor. Kellie has an intuitive understanding of what this book is all about; it was great fun to plan out the changes for the third edition of the book with her. Other members of the editorial team for the third edition included Kelly Milford, Developmental Editor, Jennifer Watrous, Senior Developmental Editor, Emily Thomson, Editorial Assistant, and Sara Alsup, Associate Project Manager. Publishing is truly a team effort, and I am grateful for everyone's support and patience.

Finally, thanks to my family for their support and understanding of what it takes to get this type of project completed.

Karen J. Tietze

CHAPTER

1 Introduction: The Practice of Clinical Pharmacy

LEARNING OBJECTIVES

- Define *pharmaceutical care* and identify the four outcomes that improve a patient's quality of life.
- Define *medication therapy management*.
- List the three goals and five core elements of medication therapy management.
- List the knowledge and skills needed for patient-focused pharmacy practice.
- State the requirements for pharmacy state licensure and relicensure.
- Differentiate between pharmacist board certification, pharmacist-specific disease-specific credentialing, multidisciplinary disease-specific credentialing, and pharmacy certificate programs in terms of eligibility and requirements.
- State the eligibility requirements for pharmacist board certification and identify the areas for which board certification is available.
- Define *residency* and *fellowship* and differentiate them with regard to length of training and mechanisms for credentialing.
- Identify and differentiate among the various types of health care settings and environments.
- Define *health maintenance organization, point-of-service plans,* and *preferred provider organizations.*
- State the purpose of the medical team and identify the roles and responsibilities of each team member.
- Identify and describe unresolved health care system issues.

Pharmacy practice is moving toward a model that integrates patient-focused care (also known as *patient-centered care*) and drug distribution services. To be successful, pharmacists must understand and speak the language of the health care system and function in a system that to the uninitiated is foreign and excessively complex. The variety of providers, rapidly evolving types of health care delivery systems, and complexities of relationships among the various heath care professionals working within the health care system add to the confusion. This chapter describes patient-focused pharmacy practice and the clinical environment in which patient-focused pharmacists function.

PATIENT-FOCUSED PHARMACY PRACTICE

The term *clinical pharmacy* historically described patient-oriented rather than product-oriented pharmacy practice. The term *clinical pharmacist* was used to describe a pharmacist whose primary job was to interact with the health care team, interview and assess patients, make patient-specific therapeutic recommendations, monitor patient response to drug therapy, and provide drug information. Clinical pharmacists, working primarily in acute care settings, were viewed as "drug experts"; other pharmacists could occasionally use "clinical" skills, but they remained focused on product management. The pharmacy profession has evolved to the point that many pharmacists find the term *clinical pharmacy* redundant; the term *pharmacist* implies the integration of patient- and product-oriented pharmacy practice.

Patient-focused pharmacists work closely with physicians and other health care professionals to provide optimal patient care. Some pharmacists in traditional product-centered practice settings use clinical pharmacy skills in a limited capacity, such as when they obtain a medication history or triage a patient to self-care with nonprescription drugs. Some pharmacists have no traditional product-centered responsibilities and instead provide full-time patient-focused care. Regardless of the setting and the degree to which patient-focused skills are used, patient-focused care is an integral part of the practice of pharmacy (Figure 1-1).

The term *pharmaceutical care* is used to describe the broad-based, patient-focused responsibilities of pharmacists (see Figure 1-1). Hepler and Strand define pharmaceutical care as the "responsible provision of drug therapy for the purpose of achieving definite outcomes that improve a patient's quality of life."[1] The four outcomes identified include the following:

1. Cure of disease
2. Elimination or reduction of symptoms
3. Arrest or slowing of a disease process
4. Prevention of disease or symptoms

Pharmaceutical care requires an expert knowledge of therapeutics; a good understanding of disease processes; knowledge of drug products; strong communication skills; drug monitoring, drug information, and therapeutic planning skills; and the ability to assess and interpret physical assessment findings (Figure 1-2).

Figure 1-1 Patient-Focused Care in the Community Pharmacy. Patient-focused care is an integral part of the practice of pharmacy in all patient care settings. (Hopper T: *Mosby's pharmacy technician: Principles and practice,* ed 2, St Louis, Saunders, 2007.)

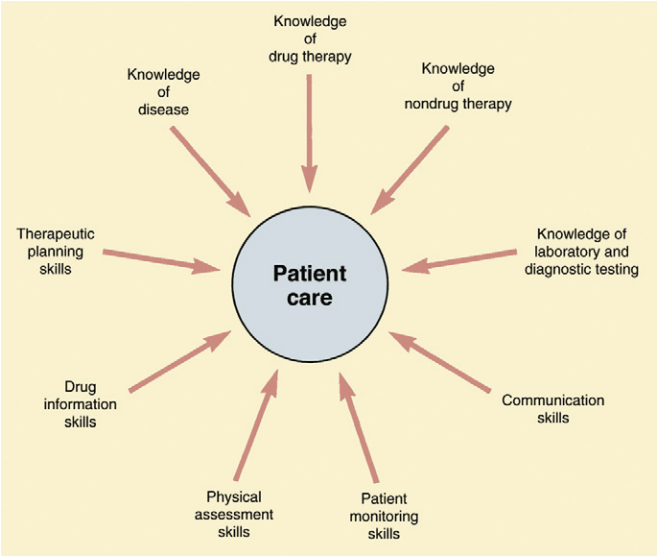

Figure 1-2 Patient Care. Patient care requires integration of knowledge and skills.

Medication therapy management (MTM) services provide pharmacists with new opportunities for direct patient care. The Medicare Prescription Drug, Improvement, and Modernization Act of 2003 (also known as the *Medicare Modernization Act*) established Medicare Part D.[2] Medicare Part D provides for prescription drug benefits for Medicare beneficiaries, including pharmacist-provided MTM services. MTM is defined as "a distinct service or group of services that optimize therapeutic outcomes for individual patients. Medication Therapy Services are independent of, but can occur in conjunction with, the provision of a medication product."[3] The goals of MTM services include improved medication understanding, adherence and detection of medication-related problems, including adverse drug reactions.[4] MTM services include a wide range of responsibilities and activities (Box 1-1).

Box 1-1 Medication Therapy Management (MTM) Core Elements

- Provide a comprehensive or targeted medication therapy review
- Complete and update the patient's personal medication record (PMR)
- Develop a medication-related patient-directed action plan (MAP)
- Intervene and/or refer when appropriate
- Document all services and interventions, communicate results of the MTM encounter, and provide appropriate follow-up

Adapted from Bluml BM: Definition of medication therapy management: development of profession wide consensus. *J Am Pharm Assoc* 45:566-572, 2005.

Box 1-2 Pharmacist Practice Areas

Ambulatory care
Critical care
Drug information
Geriatrics and long-term care
Internal medicine and subspecialties
Cardiology
Endocrinology
Gastroenterology
Infectious disease
Neurology
Nephrology
Obstetrics and gynecology
Pulmonary disease
Psychiatry
Rheumatology
Nuclear pharmacy
Nutrition
Pediatrics
Pharmacokinetics
Surgery

SITES AND TYPES OF PRACTICE

Patient-focused pharmacy practice is performed everywhere patients interact with the health care system, including community pharmacies, outpatient clinics, teaching and community hospitals, long-term care facilities, and home health care. Pharmacists, like other health care professionals, specialize in practice areas such as pediatrics, critical care, nutrition, and cardiology (Box 1-2). Some practice areas (e.g., infectious disease, nutrition) parallel and are similar to traditional medical specialty and subspecialty areas. Other specialty practice areas (e.g., drug information, pharmacokinetics) are unique to pharmacy.

REQUIREMENTS AND VOLUNTARY CREDENTIALING AND CERTIFICATE PROGRAMS

Requirements

Licensure. To be eligible for licensure, pharmacists must be graduates of a college of pharmacy accredited by the American Council on Pharmaceutical Education (ACPE)

or from a pharmacy school approved by the state board of pharmacy. Pharmacists who graduated from foreign pharmacy schools are eligible for licensure if they have earned the Foreign Pharmacy Graduate Examination Committee (FPGEC) certification or follow other state-specific requirements. All states except California require successful completion of the North American Pharmacist Licensure Examination (NAPLEX). (California administers its own licensing examination.) All states require that licensure candidates complete a specified number of internship hours, typically around 1500 hours, prior to seeking licensure. Some states allow the internship hours to be earned prior to graduation from pharmacy school; some states require that some or all of the hours be earned after graduation. Many states also require successful completion of the Multi-State Pharmacy Jurisprudence Examination (MPJE). Some states still require successful completion of a laboratory ("wet lab") examination. Licensure for authorization to administer injectable medications (e.g., immunizations) is a separate but parallel licensing process.

Relicensure. Most licensing boards require that pharmacists earn continuing education units (CEUs) for relicensure. The CEUs are earned by successful participation in ACPE-accredited continuing education programs (e.g., live programs and continuing education articles in professional journals). Some states require that pharmacists earn some of the CEUs by participating in specific types of continuing education programs (e.g., live programs). Some states require specific content (e.g., human immunodeficiency virus [HIV] or immunization continuing education).

Voluntary Credentialing and Certificate Programs

Postlicensure credentialing. Postlicensure credentialing is voluntary and is available at the specialist or disease level. Postlicensure credentials indicate that the pharmacist has additional expertise above and beyond what is required for licensure (Figure 1-3). The Council on Credentialing in Pharmacy (CCP) defines certification as "a voluntary process through which a nongovernmental agency or an association grants recognition to an individual who has met certain predetermined qualifications specified by that organization. This formal recognition is granted to designate to the public that this individual has attained the requisite level of knowledge, skill, and/or experience in a well-defined, often specialized, area of the total discipline."[5] The term *certification* should not be confused with the term *certificate,* which is the document given to a person upon completion of a program.

Specialist credentialing. Board certification (official recognition of specific knowledge and skills) is achieved in addition to state and federal professional licensure. Some employers require board certification for specific jobs, whereas other employers reward pharmacists who become board certified with additional career advancement opportunities and salary differentials. The Board of Pharmacy Specialties (BPS), created in 1976 by the American Pharmacists Association (APhA), is responsible for setting standards for certification and recertification and for administering the certification and recertification processes. Five specialty practice areas are recognized by the BPS[6] (Table 1-1). Requirements vary by board. For example, BPS board certification requires an entry-level pharmacy degree (bachelor of science in pharmacy or doctor of pharmacy), an active pharmacy license, additional experience and/or training (residency or fellowship) in the specialty area, and passage of a specialty-specific written examination. Recertification is required every 7 years. The BPS also recognizes additional expertise within a subspecialty area by the designation "Added Qualifications (AQ)" (e.g., Board Certified with Added Qualifications). Added Qualifications in infectious diseases pharmacotherapy and cardiology pharmacotherapy are currently available within the pharmacotherapy specialty practice area. The Added Qualifications designation is earned by demonstrating the additional expertise through a portfolio process (Box 1-3).

Multidisciplinary disease-specific credentialing: A variety of health care professionals, including pharmacists, are eligible for certification in select disease-specific

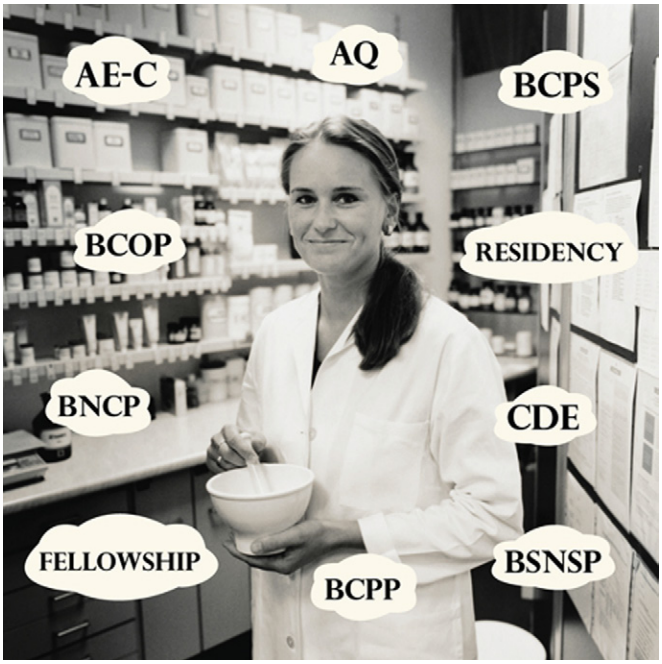

Figure 1-3 Pharmacist Credentials. Pharmacists are eligible for a variety of voluntary credentials. (Jupiter Images)

Table 1-1 Board of Pharmacy Specialties (BPS) Recognized Pharmacy Specialties

Specialty	Acronym	Initial Recognition
Nuclear Pharmacy	BCNP	1978
Pharmacotherapy	BCPS	1988
Nutrition Support Pharmacy	BCNSP	1988
Psychiatric Pharmacy	BCPP	1992
Oncology Pharmacy	BCOP	1996

BCNP, Board Certified Nuclear Pharmacist; *BCNSP,* Board Certified Nutrition Support Pharmacist; *BCOP,* Board Certified Oncology Pharmacist; *BCPP,* Board Certified Psychiatric Pharmacist; *BCPS,* Board Certified Pharmacotherapy Specialist.

multidisciplinary certification programs (Table 1-2). Requirements are different for each program. For example, the 2010 requirements for application for the Certified Diabetic Educator (CDE) program include a minimum of 2 years of professional practice, completion of a minimum of 1000 hours of diabetes self-management education (DSME), completion of a minimum of 15 hours of relevant continuing education activities within the 2 years prior to application, and status as either a licensed clinical psychologist, registered nurse, occupational therapist, optometrist, pharmacist, physical therapist, physician (MD or DO), or podiatrist, or as a registered dietitian, physician assistant, exercise physiologist, or other health care professional with a minimum of a master's degree.[7]

Certificate programs. In 2000, the ACPE assumed responsibility for voluntary pharmacy certificate programs based on specific professional competencies (Pharmacy-Based Immunization Delivery, Pharmaceutical Care for Patients with Diabetes, Pharmacy-Based Lipid Management, OTC Advisor: Advancing Patient Self-Care, and Delivering Medication Therapy Management Services in the Community). Pharmacists who successfully complete a postgraduate certificate program receive a certificate documenting successful completion of the program. Certificate programs are voluntary and do not require any additional training or experience beyond that required for pharmacy licensure. ACPE certificate programs provide at least 15 hours of programming that must include practice experiences to demonstrate the given professional competency. Participants are evaluated by a summative evaluation process. Completion of a certificate program provides evidence of achievement of professional competencies beyond those required for pharmacy licensure.

Box 1-3 Portfolio Requirements for Added Qualifications in Cardiology

- Letter requesting portfolio review
- Detailed summary of each of the following elements:
  - Specific and current professional responsibilities
  - Bibliography of professional publications
  - Past (within last 7 years) and present research and other scholarly activities
  - Past (within last 7 years) and current activities in didactic or clerkship, residency, or fellowship education of health care professionals in cardiovascular pharmacotherapy
  - Current memberships in professional organization related to cardiology
  - Special or unique training or professional development programs
  - Professional awards, honors, or special achievements related to cardiovascular pharmacotherapy
- Current curriculum vitae

From Board of Pharmacy Specialties: Current Specialties. Available at: http://www.bpsweb.org/specialties/specialties.cfm. Accessed October 12, 2009.

Postlicensure residency and fellowship training programs. Pharmacy graduates obtain additional experience, knowledge, and skills by completing a variety of residency and fellowship postgraduate training certificate programs. Most residency and fellowship programs require candidates to have either entry-level or postbaccalaureate doctor of pharmacy degrees. The American Society of Health-System Pharmacists (ASHP) publishes a directory of ASHP-accredited residency programs. The American College of Clinical Pharmacy (ACCP) publishes a directory of residency and fellowship programs offered by members of the ACCP. The APhA provides a searchable on-line community pharmacy residency locator directory.

A *residency* is defined as an "organized, directed, postgraduate training program in a defined area of pharmacy practice"[8] (Table 1-3). Residencies provide pharmacists with 1 to 2 years of supervised experience in practice and management activities. Postgraduate year 1 (PGY-1) residency programs train generalists; postgraduate year 2 (PGY-2) residency programs train pharmacists in a specialty patient care area. Residents generally gain experience by providing a variety of inpatient and outpatient pharmacy services under the supervision of one or more preceptors. Most residencies are based in hospitals; however, increased interest in community pharmacy and ambulatory care residencies has resulted in the creation of an increasing number of community pharmacy and ambulatory care residency programs. The ASHP accredits residency programs, but there are many nonaccredited residency programs.

A *fellowship* is a highly individualized program designed to prepare the pharmacist to become an independent researcher.[8] Fellows spend approximately 80% of their time in research-related activities. Currently no mechanism for accreditation of fellowship programs is available. However, the ACCP Fellowship Review Committee conducts a voluntary peer review of fellowship programs. As of 2009, 17 fellowship programs were

Table 1-2 Examples of Multidisciplinary Credentials

Specialty	Credentialing Organization	Title	Acronym
Anticoagulation	National Certification Board for Anticoagulation Providers	Certified Anticoagulation Care Provider	CACP
Asthma	National Asthma Educator Certification Board	Certified Asthma Educator	AE-C
Diabetes	National Certification Board for Diabetic Educators	Certified Diabetic Educator	CDE
Lipidology	Accreditation Council for Lipidology	Clinical Lipid Specialist	CLS
Pain	American Academy of Pain Management	Credentialed Pain Practitioner	CPP
Toxicology	American Board of Applied Toxicology	Diplomate of the American Board of Applied Toxicology	DABAT

Table 1-3 Residencies and Fellowships

Feature	Postgraduate Year 1 Residency Programs (PGY-1)	Postgraduate Year 2 Residency Programs (PGY-2)	Fellowship Programs
Credential earned	Certificate	Certificate	Certificate
Program accreditation	ASHP	ASHP	No official accreditation body (ACCP provides specific guidelines)
Duration	1 year	1 year	Minimum of 2 years
Prerequisites	Graduate of an ACPE-accredited pharmacy program	PGY-1 residency program	Residency or equivalent experience
Focus	Medication use management systems; medication therapy outcomes for a wide variety of patients and diseases	Knowledge, skills, attitudes, and abilities in a selected area of patient care*	Research-related activities, teaching and clinical practice in a selected area of research†

ACCP, American College of Clinical Pharmacy; *ACPE,* American Council on Pharmaceutical Education; *ASHP,* American Society of Health-System Pharmacists.
*ASHP-accredited PGY-2 residency areas include ambulatory care, cardiology, critical care, drug information, emergency medicine, geriatrics, health systems pharmacy administration, infectious diseases, human immunodeficiency virus, informatics, internal medicine, managed care pharmacy systems, medication use safety, nuclear pharmacy, nutrition support, oncology, pain and palliative care, pediatrics, pharmacotherapy, psychiatry, and solid organ transplant.
†ACCP-recognized fellowship programs include those with the following areas of emphasis: ambulatory care, cardiology, clinical pharmacology, critical care, drug metabolism, infectious disease, oncology, pediatrics, pharmacodynamics, pharmacoeconomics, pharmacoepidemiology, and pharmacokinetics.

recognized as meeting the ACCP Guidelines for Research Fellowship Training Programs. Nonaccredited fellowship programs are available.

THE CLINICAL ENVIRONMENT

Health care is provided in many different settings (Box 1-4). Examples of outpatient (ambulatory) settings include private offices, outpatient clinics, day surgery units (also known as *short procedure units*), and emergency departments. Acute care hospitals provide inpatient care. Patients are hospitalized for major surgery, treatment of acute disorders, and diagnostic evaluations and procedures. Long-term care facilities, such as nursing homes and rehabilitation centers, provide health care for patients who require skilled management of chronic disorders. Home health care services are available for chronically ill and disabled patents.

Inpatient and outpatient health care services are provided to patients through individual or group practices. Group practices consist of health care professionals with similar practices (e.g., family medicine, obstetrics) or with multiple specialties (e.g., internal medicine, family medicine, and obstetrics and gynecology). Health care professional practices changed dramatically in response to the 1990s evolution of heath care delivery from traditional fee-for-service (FFS) indemnity insurance plans in which patients were free to select any physician, hospital, or laboratory they wanted to managed care insurance plans such as health maintenance organizations (HMOs), point-of-service (POS) plans, and preferred provider organizations in which care is coordinated through a primary care provider and patients have less freedom of choice (Table 1-4).

Many different alliances have formed among physicians, nurse practitioners, physician assistants, health care institutions, and insurers, including provider networks, prepaid group practices, and integrated delivery systems. The *medical home* is a relatively new concept.

Box 1-4 Health Care Settings

OUTPATIENT
Clinics
Day surgery units
Emergency departments
Home health care
Private offices

INPATIENT
Hospitals

LONG-TERM CARE FACILITIES
Rehabilitation centers
Skilled nursing homes

Table 1-4 Basic Health Care Plans

Health Care Plan	Acronym	Characteristics
Fee for service	FFS	Patients may select any doctor, hospital, or laboratory without permission of primary care physician (PCP). Patients pay up front then submit the bill for reimbursement.
Health maintenance organization	HMO	Patients must choose a PCP and are restricted to in-network doctors. Referrals are made through the PCP.
Point of service	POS	Similar to HMO but with fewer restrictions.
Preferred provider organization	PPO	Permission is not required to see in-network specialists; some coverage for out-of-network care.

Defined by the Association of American Medical Colleges as "a concept or model of care delivery that includes an ongoing relationship between a provider and patient, around-the-clock access to medical consultation, respect for a patient's cultural and religious beliefs, and a comprehensive approach to care and coordination of care through providers and community services,"[9] the medical home concept is of increasing interest to patients and health care professionals.

Clinics, often affiliated with major medical centers and hospitals, are located in a variety of outpatient settings, including community centers, medical offices, community pharmacies, and freestanding clinics. Clinics serve general unrestricted patient populations or very specific patient groups (e.g., hypertension clinic, diabetes clinic, anticoagulation clinic, medication refill clinic). Several clinics may share the same physical space; in this situation the schedule is set to allow each clinic to have a unique weekly or daily schedule (e.g., anticoagulation clinic on Tuesday afternoons, diabetes clinic on Wednesday mornings, hypertension clinic on Friday mornings).

Hospitals are identified as public, private, or federal hospitals, depending on the funding source. Public hospitals are publicly funded and provide heath care services to all patients, regardless of the patient's type of insurance or ability to pay for the health care services. Some cities and states pay for public hospital services from tax revenues. Private hospitals are privately funded institutions whose services are generally not available, except for emergency care, to patients who are not part of the private group. The federal government funds federal hospitals. The Veterans Administration hospital system is an extensive nationwide system of hospitals, clinics, and nursing homes funded by the federal government to provide health care services to American armed forces veterans.

Hospitals, regardless of the funding source, may be affiliated with medical schools. These hospitals, known as *teaching hospitals,* provide training sites for physicians and other health care professionals. Community-based, nonteaching hospitals are sometimes called *community hospitals*. Some hospitals, recognized for their highly specialized services (e.g., pediatrics, oncology, cardiology) and large referral patient populations, are known as *tertiary hospitals.*

HEALTH CARE PROFESSIONALS

The American Medical Association recognizes more than 80 health care–related careers, including physician, pharmacist, nurse, and allied health professional.[10] Allied health care professionals, also known as *paramedicals,* provide health care services and perform tasks under the direction of physicians (Box 1-5).

Physicians

Physicians, doctors who have medical or osteopathic degrees, are generally considered the health care team leaders. Allopathic physicians rely on standard treatment modalities; osteopathic physicians use the additional technique of spine and joint manipulation to treat disease.

Box 1-5 Allied Health Care Professionals

Anesthesiologist assistant
Anesthesia technologist/technician
Athletic trainer
Cardiovascular technologist
Electroneurodiagnostic technologist
Emergency medical technician/paramedic
Exercise scientist
Kinesiotherapist
Medical assistant
Medical illustrator
Occupational therapist
Orthotist and prothetist
Perfusionist
Polysomnographic technologist
Respiratory therapist
Surgical assistant
Surgical technologist

From Careers in Health Care. Available at: http://ama-assn.org/ama/pub/education-careers/careers-health-care/directory.shtml. Accessed October 21, 2009.

Physicians are licensed by individual states and credentialed by national examination. A physician must graduate from an accredited medical school, receive passing grades on the medical licensure examination, and complete 1 year of an accredited residency program to become licensed to practice medicine. The United States Medical Licensing Examination (USMLE) consists of four examinations taken sequentially starting during medical school and finishing after completion of the medical degree (Table 1-5).[11] Relicensure requires successful completion of the number of continuing medical education (CME) credits specified by the state in which the physician practices. Most physicians complete 1 year or more of supervised experience in residency programs; some complete additional training in highly specialized fellowship programs. The length of the residency program depends on the specialty or subspecialty. Internal medicine residencies are typically 3 years in duration; surgical residencies may be 5 to 7 years.

Board certification is a voluntary but increasingly important credential for physicians. Many health care plans require board certification for inclusion in member networks; many hospitals require board certification for admitting privileges. Approximately 87% of physicians are board certified.[12] There are 26 approved medical board specialties. The American Board of Medical Specialties (ABMS), a group of 24 member boards, certifies more than 145 physician specialties and subspecialties (Box 1-6).[13] For example, there are 21 internal medicine subspecialties (Box 1-7).[14] Board certification is a comprehensive process involving peer evaluation, specific educational requirements, and examination. Maintenance of certification (MOC; recertification) is required and occurs at 6- to 10-year intervals depending on the specific specialty. MOC requires an active and unrestricted license in the state in which the physician practices, periodic self-evaluation of knowledge (continuing education), assessment of knowledge by examination, and assessment of practice performance.[12]

Table 1-5 United States Medical Licensing Examination (USMLE)

Step	Taken By	Content
Step 1	Medical students and graduates seeking to practice medicine in the U.S.	Basic science knowledge
Step 2 Clinical Knowledge	Medical students and graduates seeking to practice medicine in the U.S.	Normal conditions and disease and physician tasks (preventive medicine, health maintenance, disease mechanisms, determination of a diagnosis, patient management)
Step 2 Clinical Skills	Medical students and graduates seeking to practice medicine in the U.S.	Integrated clinical encounters, communication and intrapersonal skills, spoken English proficiency
Step 3	Those who have successfully completed Step 1 and Step 2 Clinical Knowledge and have a medical degree (MD, DO)	Normal conditions and disease categories, clinical encounter, physician tasks, common clinical scenarios

From United States Medical Licensing Examination. Available at: http://www.usmle.org. Accessed October 22, 2009.

Box 1-6 American Board of Medical Specialties Member Boards

Allergy and Immunology
Anesthesiology
Colon and Rectal Surgery
Dermatology
Emergency Medicine
Family Medicine
Internal Medicine
Medical Genetics
Neurological Surgery
Nuclear Medicine
Obstetrics and Gynecology
Ophthalmology
Orthopaedic Surgery
Otolaryngology
Pathology
Pediatrics
Physical Medicine and Rehabilitation
Plastic Surgery
Preventive Medicine
Psychiatry and Neurology
Radiology
Surgery
Thoracic Surgery
Urology

From About ABMS Member Boards. Available at: http://www.abms.org/About_ABMS/member_boards.aspx. Accessed October 22, 2009.

Box 1-7 American Board of Internal Medicine Specialties

Internal Medicine
Adolescent Medicine
Advanced Heart Failure and Transplant Cardiology
Allergy and Immunology
Cardiovascular Disease
Clinical Cardiac Electrophysiology
Critical Care Medicine
Endocrinology, Diabetes, and Metabolism
Gastroenterology
Geriatric Medicine
Hematology
Hospice and Palliative Medicine
Infectious Disease
Interventional Cardiology
Medical Oncology
Nephrology
Pulmonary Disease
Rheumatology
Sleep Medicine
Sports Medicine
Transplant Hepatology

From Details about Each Exam by Specialty. Available at: http://www.abim.org/exam/exams.aspx. Accessed October 22, 2009.

Nurses

Nurses care for the physical and psychosocial needs of patients and carry out physician-directed orders regarding patient care. Nurses may have an associate degree in nursing (ADN) obtained from a 2-year junior or community college, a diploma from a 2- to 3-year nursing program offered by some hospitals and private schools, or a bachelor of science in nursing (BSN) degree from a 4-year college or university. Graduates from all three programs are eligible for licensure as registered nurses (RNs). Continuing licensure is often contingent on completion of continuing nursing education requirements. Nurses may specialize in any of more than 38 categories related to disease states, patient age, and acuity of illness. Certification is available for some of these specialties. For example, nurses can be certified in critical care and are then entitled to use the designation Certified Critical Care Registered Nurse (CCRN) in their titles.

Nurse Practitioners

The American Academy of Nurse Practitioners (AANP) defines nurse practitioners (NPs) as "licensed independent practitioners who practice in ambulatory, acute and long term care as primary and/or specialty care providers."[15] NP education is shifting from master's degrees and/or post-master's certificates to the doctor of nursing practice (DNP). Regulated by state boards of nursing, NPs may practice independently or in collaboration with

other health care professionals. NPs typically have unlimited prescriptive authority.

Physician Assistants

The American Academy of Physician Assistants (AAPA) defines physician assistants (PAs) as "health care professionals licensed, or in the case of those employed by the federal government they are credentialed, to practice medicine with physician supervision."[16] PAs perform many routine tasks (patient interviews, patient examinations), order and interpret laboratory and diagnostic tests, treat minor illness, counsel patients, and provide patient education. PAs can prescribe medications in many states. PAs may have certificates, associate degrees, or master's degrees. Most states require graduates of accredited programs to pass certifying examinations. Those who pass the examination may use the designation "Physician Assistant–Certified (PA-C)." Continuing licensure is contingent on completion of continuing education requirements; recertification examinations must be passed periodically.

THE HEALTH CARE TEAM

The health care team consists of all health care professionals who have responsibility for patient care plus the patient (Figure 1-4). Although all members of the health care team interact directly with the patient, they rarely meet as a group; instead, information and recommendations are exchanged through written documentation. Verbal information exchange and recommendations occur on a less formal basis.

All members of the health care team contribute their profession's unique knowledge and skills. Pharmacists, the "drug experts" on the team, help teams develop, implement, and monitor the therapeutic regimen and provide drug information and education services to the patient and team.

Students have a unique role on the health care team. Students represent their profession and are expected to carry out their professional responsibilities under the direct supervision of licensed professionals. For example, pharmacy students are expected to provide patient-focused care under the direct supervision of a licensed pharmacy preceptor. Autonomy and the ability to prospectively influence the health care team gradually develop with experience. Although the types of experiences students have vary with the patient care environment, the professional responsibilities remain the same.

Figure 1-4 The Health Care Team. The health care team consists of the patient and all health care professionals taking care of the patient, including students in health care professions.

THE MEDICAL TEAM

Teaching hospitals are the primary training sites for most health care professionals. Health care services in teaching hospitals are structured around medical teaching teams composed of physicians, medical students, and, depending on the hospital, other health care professionals (Box 1-8). Medical teams, organized to provide a structured training environment, are responsible for the care of patients located in assigned areas of the hospital (e.g., the cardiology unit) or patients located throughout the hospital (e.g., patients with infectious disease or renal disease). The team may provide consultative services in a medical subspecialty (e.g., dermatology) or be identified with a specific physician group practice. The medical team functions as a unit, with the division of labor and the responsibility of each member determined according to the status of each individual. The team is structured so that each team member receives guidance from a more experienced health care professional. The team is the focus for group teaching and decision-making discussions. Most trainees spend about 4 weeks with a specific team. Physician team members include, in order of seniority, the attending physician, fellows, residents, and medical students.

Attending Physician

The attending physician is the senior physician on the medical team. The attending physician assumes responsibility for all patients assigned to the team and provides guidance and direction to team members. During team rounds, the attending physician leads the team through the decision-making process, helps the team make decisions regarding patient care, and evaluates the performance of individual team members. Patient presentations may take place in a conference room, in the hallway outside of the patient's room, or in the patient's room. The

Box 1-8 Medical Team Composition in Teaching Hospitals

TYPICAL TEAM MEMBERS
Attending physician
Senior or junior medical resident
Intern
Senior medical student
Junior medical student

OTHER TEAM MEMBERS
Medical ethicist
Nurse
Occupational therapist
Pharmacist
Respiratory therapist
Social worker
Students (dental, nursing, pharmacy)

attending physician spends a short portion of the day with the team and is available for consultation (usually by telephone) throughout the rest of the day, 24 hours a day, 7 days a week.

Fellows

Medical fellows are physicians who have completed residency training and have elected to continue their training in a research-oriented fellowship program. Fellows work closely with the attending physician and have fewer direct patient care responsibilities than residents. Fellows teach the more junior members of the team. In some fellowship programs, fellows are responsible for performing specific invasive procedures such as arterial line placement, bronchoscopy, and endoscopy. Research-intensive, multiyear fellowship programs in medical subspecialty areas such as gastroenterology, cardiology, neurology, and pulmonary medicine are available at many major teaching hospitals.

Residents

Medical residents are physicians who have graduated from medical school and are in structured and supervised residency training programs.

First-year residents (sometimes designated as *postgraduate year 1, PGY1,* or *PG1* trainees) are known as *interns*. Internal medicine internships of at least 1 year often are required before the resident moves on to more specialized training in areas such as surgery or psychiatry. The intern year also is the first of several years of training for physicians interested in practicing internal medicine. Interns, who are licensed physicians, have an intensive year of training, with frequent night call duty and direct responsibility for the care of a variety of inpatients and outpatients. Interns typically spend 1-month periods gaining experience in a variety of internal medical services such as general medicine, emergency department services, and intensive care services. In addition, interns usually have set clinic hours and care for a variety of outpatients over the course of the year.

Second-year internal medicine residents (sometimes designated as *postgraduate year 2, PGY2,* or *PG2* trainees) also are known as *junior admitting residents* (JARs). *Third-year medical residents* (sometimes designated as *postgraduate year 3, PGY3,* or *PG3* trainees), also known as *senior admitting residents* (SARs), are in the final year of 3-year internal medicine residency programs. The senior medical resident sets the daily team rounding schedule, prioritizes the work schedule, coordinates the team's work, supervises the interns, supervises and works closely with the medical students on the team, and consults with the attending physician. Residents have frequent night call duty and direct responsibility for a variety of inpatients and outpatients.

The *chief medical resident* is a senior medical resident who, in addition to the usual resident responsibilities, has administrative responsibility for various aspects of the residency program, such as scheduling rotations and vacations and organizing and overseeing seminars and other education programs. The chief medical resident position is competitive; typically one or two residents per year are selected for this position.

Medical Students

Although medical students get some experience examining and interviewing patients in the first or second year of medical school, clinical clerkships usually start in the third year of medical school. Third-year medical students, known as *junior medical students,* spend part of the year in the patient care environment in month-long rotations such as internal medicine, surgery, obstetrics and gynecology, and pediatric services. Their patient workloads are limited to a small number of patients, and medical school faculty and more experienced team members closely supervise them. Senior medical students, also known as *externs,* are in the last year of medical school. Depending on the medical school curriculum, senior medical students may spend all or part of the last year of medical school in a variety of selective or elective rotations. Externs have more patient care responsibilities than do junior medical students but less than interns or other residents.

The medical team, depending on institution-specific policies, may include a variety of other health care professionals. Some pharmacists provide patient care services to specified patient populations (e.g., oncology, critical care, nutrition, transplant, or nephrology patients) and are considered integral members of the medical team. Pharmacy residents, fellows, and students often are assigned to specific medical teams for part of their experiential training. NPs and PAs may provide patient care services to specific patient populations and attend rounds with the medical team. More commonly, nurse specialists join the medical team as the team discusses specific patients and patient-specific issues. Nursing students may be assigned to medical teams as part of their experiential training. Other health care professionals who may be part of the team or join the medical team on rounds to specific patients include social workers, dietitians, medical ethicists, occupational therapists, physical therapists, and respiratory therapists.

THE INPATIENT ENVIRONMENT

Patients admitted to the hospital are assigned beds on specific floors, wards, or wings according to the specific medical problem (e.g., obstetrics, general medicine, cardiology, orthopedics). The admitting physician evaluates the patient and orders laboratory tests, procedures, diets, and medications. The admitting physician may consult with specialty physicians and other health care professionals, including pharmacists. In a teaching hospital, medical residents, interns, and medical students also evaluate the patient; the physician of record (the resident or intern) generates patient orders and consults with a variety of physicians and other health care professionals regarding patient care.

Nursing services are organized to provide 24-hour nursing coverage for all patients. The number of patients assigned to each nurse depends on the severity of the patients' illnesses or disabilities and ranges from 1 or more nurses per critically ill patient to 10 or more patients per nurse on other units. Each floor, unit, or ward has a head nurse with administrative responsibility for nursing services. Some hospitals assign each patient to a primary NP who determines the nursing care plan for the patient and coordinates patient care.

Figure 1-5 The Hospitalized Patient. Team rounds may be conducted in the patient's room. (From Frownfelter D: *Cardiovascular and pulmonary physical therapy: evidence and practice,* ed 4, St Louis, 2006, Mosby.)

Medical team rounds usually occur in the morning. Work rounds, led by the medical resident, usually take place early in the morning. During work rounds the patient's progress is briefly reviewed by the resident, intern, or medical student responsible for the patient; the medical team visits each patient (Figure 1-5). Work rounds allow all members of the team to catch up on the status of each patient and plan for the day's tests, consultations, and other patient care activities.

Attending rounds, led by the attending physician, generally occur after work rounds and are held in conference rooms rather than at the patient's bedside (Figure 1-6). Newly admitted patients are presented to the attending physician, who leads the discussion of the differential diagnosis and decision-making processes. Other patients may be discussed in detail. Although some teaching takes place during work rounds, most in-depth teaching discussions take place during attending rounds.

Team members spend the rest of the day independently evaluating patients, assessing laboratory and diagnostic test results, documenting patient findings, consulting with other health care providers, and planning for the care of their patients. The team may gather for radiology rounds, during which recent patient radiographs (e.g., chest films, computed tomography scans) are reviewed. At the end of the day the team gathers for sign-out rounds, during which the physician responsible for providing medical coverage in the evening and overnight is briefed about each patient on the service.

THE OUTPATIENT ENVIRONMENT

Physicians and other health care professionals (e.g., PAs, NPs, pharmacists) interact with and care for ambulatory patients in private offices and clinics (Figure 1-7). Some clinics provide "first come, first served" walk-in services; most require appointments. The health care professional–patient interaction generally is short (10 to 12 minutes) except for initial patient evaluations, patients with more complex problems, and outpatient procedures. Patients are referred to affiliated

Figure 1-6 Attending Team Rounds. Attending team rounds often take place in a conference room. (From Perry AG: *Clinical nursing skills and techniques,* ed 7, St Louis, Mosby.)

Figure 1-7 The Ambulatory Patient. The patient and health care professional in an ambulatory patient care setting. (From Wilson SF, Giddens JF: *Health assessment for nursing practice,* ed 4, St Louis, 2009, Mosby.)

or freestanding facilities for laboratory and diagnostic procedures such as blood work, radiography, and imaging. The results are sent to the referring health care provider.

THE MEDICAL RECORD

The inpatient medical record, also known as the *chart,* is a legal document that includes sections for hospital-specific admission and insurance information, initial history and physical examination, daily progress notes written by every health care professional who interacts with the patient, consultations, nursing notes, laboratory results, and radiology and surgery reports (Figure 1-8). Most charts include sections for medication orders and other types of orders (e.g., laboratory testing, dietary orders, diagnostic procedures; Table 1-6). Some hospitals maintain a separate ordering system. Access to patient charts is restricted to authorized health care professionals. Upon patient discharge, the medical record is stored in the medical records department and is retrievable by referencing the patient's hospital admission number.

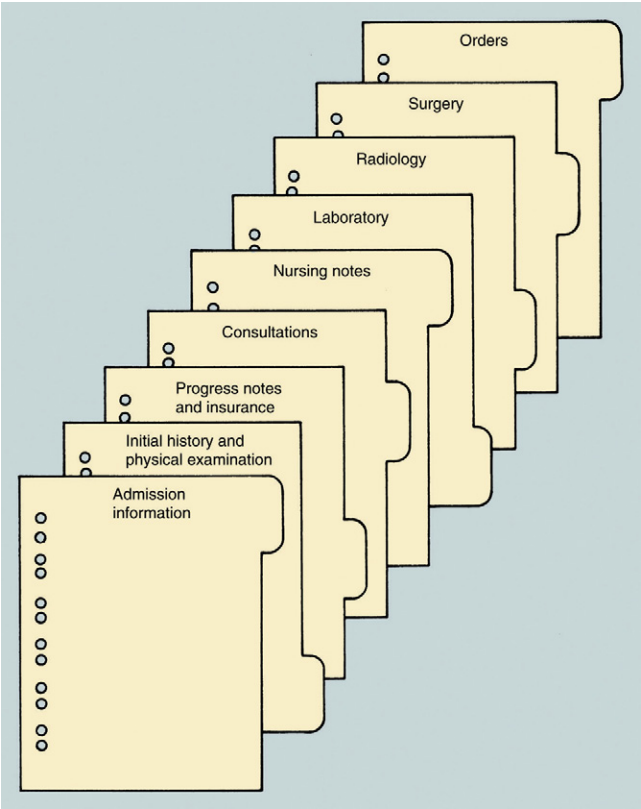

Figure 1-8 Components of the Medical Record. The medical record contains sections for many types of patient-specific information.

Table 1-6 Medical Record Content

Section	Type of Information
Admitting data*	Name, address, date of birth, insurance, next of kin
Consent forms	Consent for surgery, procedures, research studies
Physician orders	Medication, dietary, and laboratory orders
Flow sheets and graphic charts*	24-hour charts of blood pressure, heart rate, respiratory rate, temperature, and fluid intake and output
Progress notes	Physician notes, nursing shift notes, consultant notes
Laboratory data	Blood chemistry panel, arterial blood gas analysis, culture and sensitivity testing, histopathology reports
Diagnostic procedures	Radiology and other diagnostic procedures reports
Consults	Consultant assessments and recommendations
Operating room reports*	Preoperative checklist, anesthesia record, graphic records of vital signs, description of events during surgery
Admission history and physical examination*	Initial history and physical examination findings
Medication administration record*	Date, time, dose of medications administered; names and initials of nurses who administered medications; lists of all ordered medications
Miscellaneous*	Emergency department record

*Inpatient charts only.

Every page of the medical record, all patient-specific orders, and every page printed from the computerized chart is stamped or printed with a patient identification number. In most hospitals a plastic card that includes the patient's name, race, address, physician, birth date, date of admission, and hospital admission number is created upon admission. A ward secretary (also known as a *ward clerk*) coordinates the processing of paperwork on a hospital unit or part of a hospital unit. Some large units have two or more ward secretaries.

Many institutions and practices chart in a specified format known as a *problem-oriented medical record,* or *POMR*. The POMR is structured around a prioritized patient problem list. Progress notes and discharge summaries address each patient problem as itemized on the patient problem list.

The outpatient medical record or chart contains the same type of information as the inpatient chart with the exception of the admitting data, physician orders, admission history and physical examination, and medication administration sections. Outpatient charts are used more to document patient-specific encounters and data than to communicate with other health care professionals. Therefore outpatient chart documentation is limited compared with that on inpatient charts.

There is growing interest in the electronic medical record (EMR). Sophisticated computer systems enable all or part of the medical record to be accessed electronically by any member of the health care team on site or, increasingly, off site via remote access. Electronic charts contain the same sections and are structured the same as traditional written charts, although features vary by system. The typical EMR includes computerized orders for prescriptions, computerized orders for tests, test results, and health care professional progress notes.

THE HEALTH CARE DELIVERY SYSTEM

The health care delivery system in the United States has evolved over the past several decades from a system that held individuals financially responsible for all aspects of their health care to the current system, which advocates equal access and financial support for all components of health care, including sophisticated and technologically advanced health care, for all individuals. Many Americans believe that access to medical care is a national right. However, the financial burden of this belief has stimulated considerable debate regarding the best way to use limited societal health care resources.

The health care system is a complex system influenced and controlled by a variety of private and federal factors. Early attempts at some public support of needy individuals date back to the early 1700s in Colonial America; however,

Table 1-7 Public Health Policy Development

Date	Issue
1930s-1940s	Limited support for special patient populations
1940s-1950s	Support for research, facilities, and training
1960s	Broadened health care coverage
1970s	Infrastructure support
1980s-1990s	Cost, quality, and outcomes
2000s	Health care reform

Adapted from Kissick WL: The evolution of American health policy. *Trans Stud Coll Phys Phila* 11:187-200, 1989.

the prevailing attitude of the time was that individuals, not society, should pay for health care. Health care professionals and institutions were free to charge "customary, prevailing, and reasonable" fees for services; patients paid for private insurance or whatever they could afford to purchase if not covered by insurance. The health care system thus evolved to meet the needs of those who could afford to purchase expensive and inclusive services. Unfortunately, this type of health care system excluded portions of society. The federal government has had to gradually assume financial and regulatory control of larger portions of the system.[17] Public health policy evolved from a focus on limited support for special patient populations in the 1930s and 1940s to interest in cost, quality, and outcomes in the 1990s to health care reform in the 2000s (Table 1-7).

Many health care issues remain unresolved. The most pressing of these is how to decrease costs while maintaining high-quality health care. Inequities in the health care system are significant; approximately 15.4% of the U.S. population did not have health insurance coverage in 2008.[18] People with preexisting medical conditions routinely are denied health insurance. The number of unoccupied hospital beds is large, which increases competition in the provision of traditional and new hospital services. Regional oversupply and undersupply of physicians and other health care professionals exists. The cost of medical malpractice to both the physician and the health care system is high. Defensive medicine accounts for an estimated 15% of the total U.S. expenditures for physician services. The historic health care reform bill signed into law by President Obama in March 2010 begins to address many of these issues, but until its provisions are fully implemented, the impact and cost of reform remain unknown. In addition, the roles of pharmacists, nurses, and PAs are still evolving, and many questions regarding authority and responsibility for patient care remain unanswered.

APPLICATION ACTIVITY

Activity 1-1

The goal of this activity is to explore group dynamics as a team assembles a 100-piece jigsaw puzzle. This activity is best performed in small groups (five or six people).

Each team identifies a leader and a "latecomer." Give the "latecomer" a few pieces of the puzzle and have him or her go to another room or another area of the room away from the team. Show each team leader the picture of the puzzle but do not give the leader the picture. Give the leader the rest of the puzzle pieces. Tell the team leader that this is a competition between teams to see which team can assemble its puzzle first. Give the teams about 20 minutes to assemble the puzzles. Send the "latecomers" back to their teams after 15 minutes. After the puzzles are assembled, discuss the following questions.

- Describe the team leader's leadership style. Was the leadership style effective for this group and this task?
- How well did the team work together? Did everyone contribute? Would you change the group dynamics if you had another task to accomplish?
- How did the "latecomer" feel when he or she joined the team? Did the team welcome or ignore the "latecomer"?
- How did the team feel about being interrupted by the "latecomer"?

SELF-ASSESSMENT QUESTIONS

1. Which one of the following is *not* an outcome included in the definition of *pharmaceutical care?*
   a. Cure of disease
   b. Elimination or reduction of symptoms
   c. Arrest or slowing of disease processes
   d. Prevention of disease or symptoms
   e. Reduction of health care costs
2. Skills required for patient-centered pharmacy practice include which of the following?
   a. Therapeutic planning and monitoring skills
   b. Physical assessment skills
   c. Communication skills
   d. All of the above
   e. None of the above
3. Which of the following is(are) core elements of MTM?
   I. Provide a comprehensive or targeted medication therapy review
   II. Complete and update the patient's personal medication record
   III. Develop a medication-related patient-directed action plan
   a. I only
   b. III only
   c. I and II only
   d. II and III only
   e. I, II, and III
4. Which of the following is a voluntary certificate program just for pharmacists?
   a. Pharmacy-Based Immunization Delivery
   b. Certified Diabetic Educator
   c. Certified Asthma Educator
   d. Added Qualifications in Infectious Disease Pharmacotherapy
   e. Clinical Lipid Specialist

5. To be eligible for board certification, pharmacists need which of the following?
   a. A doctor of pharmacy degree
   b. Advanced education and training or equivalent experience
   c. A postgraduate residency
   d. At least 5 years of work experience
   e. Three letters of recommendation
6. Board certification for pharmacists is *not* available in which one of the following areas?
   a. Pharmacokinetics
   b. Pharmacotherapy
   c. Nutrition
   d. Nuclear pharmacy
   e. Psychiatric pharmacy practice
7. Pharmacy fellowship programs prepare pharmacists to become which of the following?
   a. Educators
   b. Practitioners
   c. Business leaders
   d. Researchers
   e. Administrators
8. Outpatient health care settings include all *except* which of the following?
   a. Clinics
   b. Day surgery units
   c. Rehabilitation centers
   d. Emergency departments
   e. Private offices
9. Veterans Administration hospitals are which of the following?
   a. Public hospitals
   b. Private hospitals
   c. Federal hospitals
   d. City hospitals
   e. State hospitals
10. Which of the following team members prioritizes and coordinates the work of the medical team?
    a. Attending physician
    b. Second- or third-year resident
    c. Fellow
    d. Senior medical student
    e. Junior medical student
11. In teaching hospitals, most in-depth teaching discussions take place during which of the following activities?
    a. Sign-out rounds
    b. Work rounds
    c. Radiology rounds
    d. Attending rounds
    e. Shift change
12. Unresolved health care issues include which of the following?
    a. How to decrease the cost of quality health care
    b. The imbalance between supply and distribution of physician services
    c. The role of clinical pharmacists, NPs, and PAs
    d. All of the above
    e. None of the above

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Audio glossary terms

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CHAPTER

2 Communication Skills for the Pharmacist

LEARNING OBJECTIVES

- Describe how to promote two-way communication with patients and health care professionals.
- Identify common barriers to verbal communication and describe ways to overcome each barrier.
- List at least six guidelines for documenting patient information in the medical record.
- State how to convey respect for patients.
- Identify patient situations that affect patient-pharmacist communication and suggest ways to deal with each situation.
- State how to communicate effectively with physicians, nurses, and other pharmacists.
- Define telehealth and telemedicine.
- Identify skills for effective teaching, platform and poster presentations, and media interviews.

The ability to communicate clearly and effectively with patients, family members, physicians, nurses, pharmacists, and other health care professionals is an important skill. Some pharmacists are skilled communicators, comfortable with all types of people; other pharmacists find it difficult to communicate with health care professionals in perceived or actual positions of authority (e.g., physicians) or with patients from different socioeconomic or cultural backgrounds. Fortunately, communication skills can be learned. One incentive for improving communication skills is that pharmacists with excellent communication skills are likely to have very satisfying and successful careers. Another incentive is that the inability to communicate effectively may harm patients. Poor communication between pharmacists and patients may result in an inaccurate patient medication history and inappropriate therapeutic decisions; may contribute to patient confusion, disinterest, and nonadherence; and may add to patients' frustration with the health care system. Poor communication between pharmacists and physicians, pharmacists and nurses, and pharmacists and pharmacists may harm patients if important information is not exchanged in an appropriate and timely manner.

VERBAL COMMUNICATION SKILLS

Essential verbal communication skills include the ability to listen, understand, and respond to what people say (active listening) and the ability to interpret nonverbal communication and respond in a way that encourages continued interaction (evaluation).

ACTIVE LISTENING

Focus on the patient, family member, or health care professional. Make that person feel like the center of attention. Convey an open, relaxed, and unhurried attitude. Set aside all professional and personal distractions and really focus on the person. Prevent or minimize interruptions (e.g., beepers, cell phones, consultations).

Focus on the person and how he or she communicates (Figure 2-1). The tone and modulation of voice and number and placement of pauses may disclose how the person feels and may provide clues regarding the reliability of the patient-provided information. People who respond with a low level of energy and flat affect may be depressed. People who respond to questions tentatively and hesitantly may give unreliable information. Pauses may indicate that the person needs time to recall the information or find the right words or that the person is censoring the response or preparing to lie.

OBSERVATION AND ASSESSMENT

Effective two-way communication requires continual observation and assessment of how the other person is communicating. Body language and gestures provide important clues for the pharmacist, as well as the patient and health care provider.

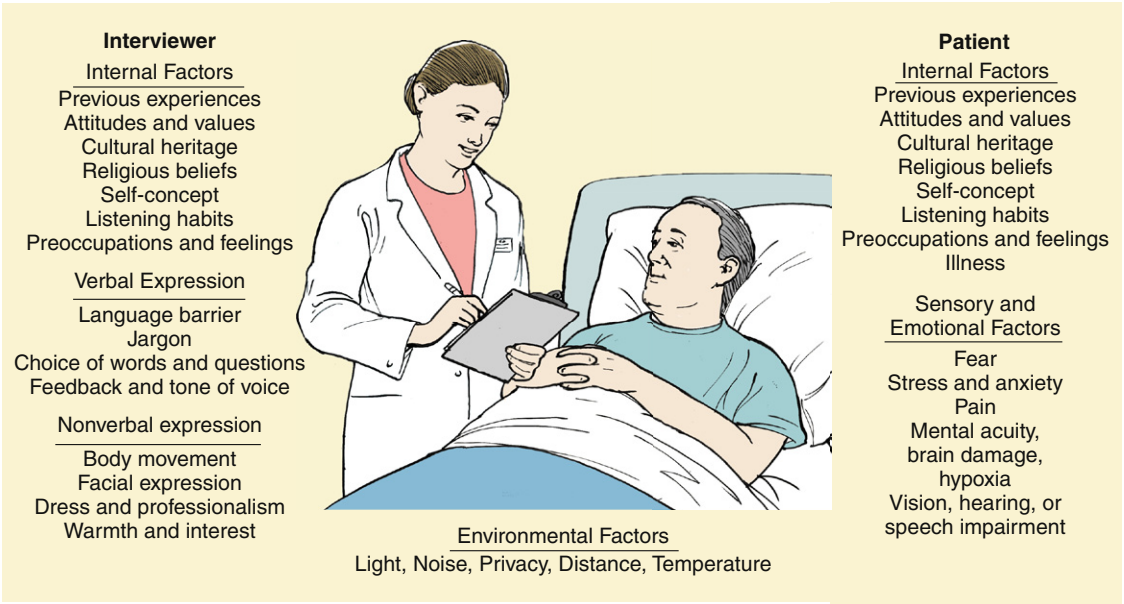


Figure 2-1 **Factors Influencing Communication.**

Figure 2-2 **Eye-Level Communication.** Sitting or standing at eye level or lower is a nonthreatening, equalizing body position that facilitates communication. (From Jarvis C: *Physical examination and health assessment,* ed 5, St Louis, 2008, Saunders.)

Sit or stand at eye level, maintain eye contact, and use a focused body posture to convey interest and attentiveness. Sitting or standing at eye level or lower is a nonthreatening, equalizing body position that facilitates open communication (Figure 2-2). Be physically close enough to the patient, family member, or health care professional for clear and comprehensible communication but do not intrude on the other person's personal space. Invasion of personal space induces discomfort and may be perceived as physically threatening; in either case, communication is compromised.

Be aware of nonverbal messages. Certain gestures and postures provide clues regarding the other person's feelings (Table 2-1), although the clues are not always reliable.

Table 2-1 Body Language

Gesture or Posture	Implication
Steepling the hands	Confidence
Raising the hand	Desire to interrupt
Shifting body position	Desire to interrupt
Crossing the arms	Shutting out of the other person
Leaning toward the speaker	Receptiveness
Raising the hands and then letting them fall limply	Hopelessness
Frequent throat clearing	Disagreement

Change tactics to reengage the person if his or her body language indicates closure to communication.

BARRIERS TO VERBAL COMMUNICATION

Physical Barriers

Communication across or through physical barriers is extremely difficult. Physical barriers commonly encountered in community pharmacies include the large countertops and display areas behind which many pharmacists work, windows with security bars and protective glass, drive-through windows that isolate the pharmacist from the patient, and the elevated pharmacy work area that accentuates the pharmacist's position of authority and places the patient in an inferior position (Figure 2-3).

Hospital and other institutional pharmacists have fewer physical barriers to contend with but have the additional problem of communicating with patients who are in bed. Patients in bed are easily intimidated by people standing over them; interviews may be strained or limited depending on the patient's level of discomfort

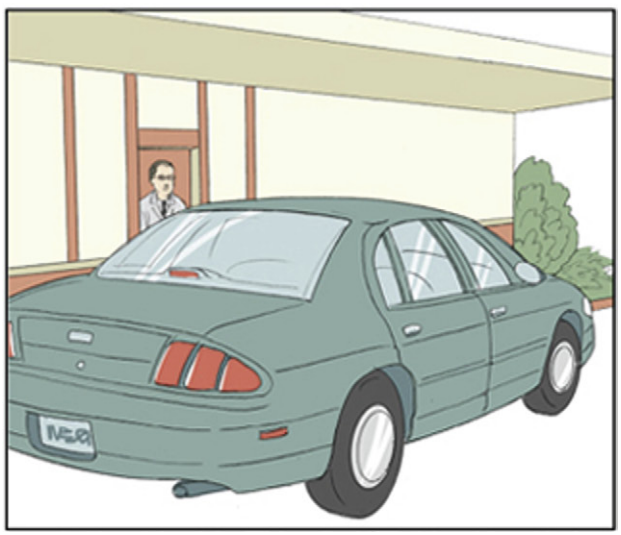


Figure 2-3 Physical Communication Barriers. Communication across or through physical barriers is difficult.

Figure 2-4 Patients in bed are easily intimidated by people standing over them; communication may be strained or limited.

Figure 2-5 Lack of privacy is a common barrier to communication.

(Figure 2-4). One way to minimize patient discomfort is to make sure that all conversations take place face to face at or below the patient's eye level.

Lack of Privacy

Lack of privacy is a common communication barrier (Figure 2-5). Although lack of privacy often is identified as a barrier to effective communication with patients, it also is an important barrier when communicating with other health care professionals. Breach of privacy is possible whenever patient information is discussed in public areas. Do not discuss or debate specific or nonspecific patient information or health care issues in public areas such as hallways, walkways, elevators, cafeterias, libraries, and parking lots. Do not discuss patient-specific information with family or friends without the permission of the patient.

Lack of privacy is a common problem in most health care settings. Few community pharmacies have private counseling areas. Most hospitalized patients have at least one roommate; three or more patients may share some hospital wards. The lack of privacy makes the voicing of personal concerns and the exchange of accurate and complete information difficult for many patients. Given a choice, patients may withhold potentially embarrassing

personal information or avoid asking potentially embarrassing or "stupid" questions if they think the conversation may be overheard.

Provide as much privacy as possible. Ideally, converse with patients and discuss patient-specific information with other health care professionals in private counseling or consultation rooms. If physically separate space is not available, converse in a space that is as private as possible. In community pharmacies, converse with patients in a corner of the pharmacy away from the cash register, drop-off windows, and pickup windows. In hospitals and other institutions, create a sense of privacy by closing the door to the room and pulling the curtain around the bed. Ambulatory institutionalized patients may be able to walk to nearby conference rooms, private consultation rooms, or vacant waiting rooms.

The Telephone

The telephone is an important communication tool used to communicate with patients, patient family members, physicians, nurses, other pharmacists, and other health care professionals. Speak clearly, listen carefully, be organized, and state facts clearly and calmly.

Those initiating the telephone conversation should identify themselves by name and state the purpose of the call. For example, when calling a physician office, say, "Hello. This is Joan Arnold. I'm the pharmacist working with Mrs. Johnson. I have a question about Mrs. Johnson's diabetic drug regimen. May I please speak with Dr. Rivers?" Be prepared to repeat the request several times before being connected to the right person. Stay patient and tolerate and expect to spend some time waiting on hold.

When answering telephone calls, identify yourself and ask for the caller's identity. Make every effort to deal with the call immediately; avoid putting the other person on hold. If you are too busy to speak with the caller at that moment, explain the situation to the caller immediately and arrange to call back at a mutually convenient time rather than placing the person on hold. Most telephone calls are directly related to patient care and need to be dealt with as soon as possible. Interruptive telephone calls should be dealt with as unhurriedly and professionally as possible.

Pharmacists sometimes receive telephone calls from angry and upset patients, patient's family members, nurses, physicians, and other health care professionals. The best way to deal with these types of calls is to stay calm, listen to what the person has to say, clarify the issue, and then handle the problem as professionally as possible. Nothing is accomplished if one or both parties let their emotions rule the interaction.

WRITTEN COMMUNICATION SKILLS

Pharmacists must be able to accurately and effectively document patient information in the patient medical record, in pharmacy medication profiles, and in other pharmacy records, and correspond with patients and other health care professionals. Many pharmacists routinely document written drug information responses; this skill is discussed in Chapter 9.

The patient medical record is the primary written communication tool for all health care professionals. Health care professionals in the outpatient setting write progress notes after each patient visit or interaction. Health care professionals who care for patients in the inpatient setting write daily progress notes in patient charts. Writing in a patient medical record (charting) is a privilege granted by each institution or organization to individual health care professionals. Many institutions and organizations grant pharmacists charting privileges, although this practice is far from universal.

The medical record ordinarily is used to document and communicate information about the patient's progress; to assess, usually retrospectively, the quality and appropriateness of patient care; and to document patient care activities and services for remuneration. Health care professionals must adhere to legal, ethical, and professional standards when documenting patient information (Box 2-1). Black ink is photocopied more clearly than other colors and is recommended just in case the patient record has to be photocopied (e.g., subpoenaed for a legal hearing or forwarded to health care professionals outside the institution or practice). Clear photocopies reduce the risk of misreading or misinterpreting the documented information. Clear and legible handwriting is important. Errors are dealt with by crossing out the error with one line and initialing the error (e.g., ~~misteak~~RS mistake). This format clearly documents the error and identifies the individual who changed the record. Products that paint over typewritten or handwritten information are not used on legal documents because they hide the error and could be used by anyone at any time to change the record.

Document factual information and restrict assessments and judgments to those appropriate for pharmacists. For example, a pharmacist may learn during a patient medication history interview that the patient drinks a fifth of whiskey and a six-pack of beer daily. It is appropriate to document the facts but inappropriate for the pharmacist to give the patient a diagnosis of alcoholism.

Every note in the patient medical record contains a descriptive heading (e.g., clinical pharmacy, pharmacokinetics, nutrition support, attending, cardiology consult), the date and time the note was written, patient-specific data and other information, and the signature and title of the health care professional. The heading identifies the type of information found in the note and enables individuals using the chart to scan the pages quickly when searching for specific information. The date and time are

Box 2-1 Guidelines for Writing Medical Record Notes

1. Use black ink.
2. Write clearly and legibly.
3. Label notes with specific descriptive headings.
4. Provide the date and time on the notes.
5. Document the facts and avoid making unsubstantiated judgments.
6. Organize the information using the SOAP (*S*ubjective, *O*bjective, *A*ssessment, *P*lan) or freestyle format.
7. Sign the note at the end of the note with name and title.

important details that put the information in context with other patient-related data and information. For example, a pharmacist may assess a patient and make drug and dosing recommendations before that day's laboratory results are available. Knowing the time of the recommendation allows the other members of the health care team to accept or reject the recommendation in the context of the most up-to-date patient data. The content of the note is organized using a SOAP format (*S*ubjective, *O*bjective, *A*ssessment, *P*lan) or a freestyle format. The SOAP format is a universally recognized structured format (see Chapter 7), whereas a freestyle format has no accepted organizational structure. The health care professional writing the note signs the note at the end of the note. Documents or notes written by students and other nonlicensed trainees are cosigned by the licensed professional who is supervising the nonlicensed individual.

Most institutions, outpatient clinics, and individual practices are transitioning from handwritten charts to electronic charts, known as the *electronic medical record* (EMR), and electronic health records (EHRs). The EMR is the document created in the clinic or during the hospitalization, whereas the EHR is a longitudinal record that includes the EMR as well as information from multiple other sources. Data are entered and viewed from any computer in the system, which eliminates "competition" for the single copy of the written chart. The electronic format limits access to confidential patient information to individuals with approved passwords but expands access to the charted information by allowing access to anyone within the password-protected system. The computer automatically labels entries with the date and time of entry and may link the entry to the password.

INTEGRATION

COMMUNICATING WITH PATIENTS

Effective communication between pharmacists and patients or family members is extremely important to pharmaceutical care. Ineffective communication leads to confusion and misunderstanding and may contribute to inappropriate decisions regarding drug therapy.

Patient Titles

Unfortunately, most health care professionals automatically address patients by their first names, even when meeting patients for the first time.[1] Some patients take offense at being addressed by their first names, especially if they are much older than the health care professional. Health care professionals who automatically expect patients to address them by title compound the offense. This expectation puts the patient in an unequal and inferior position and is a throwback to the days of paternalistic health care attitudes. Some patients offended by being addressed by their first names may openly express their displeasure. Other patients may be so put off by this behavior that they are unwilling to engage in productive conversation.

Common courtesy dictates that patients be addressed by appropriate title (e.g., Mr., Mrs., Ms., Rev., Dr.). Use the correct title, however. Do not assume that all adult women are married or, if married, wish to be addressed as "Mrs." Conversely, do not assume that all adult women, married or single, want to be addressed as "Ms." The best way to avoid confusion is to ask each patient how he or she wants to be addressed. Saying "Hello. My name is Dr. Smith. Do you wish to be called Ms. or Mrs. Sandborne or would you prefer to be called Elizabeth?" requires very little time or effort. This approach conveys a sense of respect for the patient, allows the patient to express his or her preference, and indicates to the patient how to address the health care professional. The one exception to this approach is in addressing disoriented, confused, or sedated patients; these patients usually respond better to their first names than to their titles.

Respect for the Patient

Display a genuine respect for the patient. Respond to the patient as a person, not a prescription or case (e.g., "The asthma patient in room 1012"). Maintain a professional relationship and avoid exchanging personal information and confidences with the patient, remembering that "an interview is a conversation with a purpose rather than a conversation with a potential friend."[2]

Respect for the patient is conveyed by acknowledging, without judgment, patient-specific attributes that may be different from the pharmacist's value system or even offensive to the pharmacist. Attributes such as smoking, excessive drinking, use of illicit drugs, self-destructive behaviors, nonadherence to prescribed regimens, deficient hygiene, and gross obesity may be offensive but must be dealt with nonjudgmentally. Other patient-specific traits such as beliefs in folk physiology or use of alternative medications or unorthodox medical treatments also must be acknowledged without judgment. Pharmacists also must be able to acknowledge differences in socioeconomic backgrounds and ethnic origins without passing judgment.

Respect for the patient is conveyed by the pharmacist's attitude (Box 2-2).[3] Arrange adequate time for patient interaction and minimize interruptions from phone calls, beepers, and other patients or health care professionals. Introduce yourself, obtain permission to interact with the patient, and explain the purpose of the interaction. Explain who will see the information obtained by the pharmacist and how the information will be used. Pharmacy students need to clearly identify themselves as students and explain who will see information obtained during the student-patient interaction and the way in

Box 2-2 Behavioral Checklist

Be relaxed, confident, and comfortable.
Show interest in the patient.
Maintain objectivity.
Be nonjudgmental.
Be sincere and honest.
Maintain control of the interview.

From Zakus GE, Hutter MJ, Dungy C, et al: Teaching interviewing for pediatrics. *J Med Ed* 51:325-331, 1976.

which the information will be used (e.g., for teaching purposes, for patient care, for research).

Questioning Techniques

The pharmacist, not the patient, controls the patient-pharmacist interaction. The pharmacist controls the interaction by controlling the types of questions asked and the time allowed for patient response. Controlling the interaction does not mean, however, that the pharmacist should fire off a rapid sequence of yes/no questions or abruptly cut off patient response. Questioning skills improve as the pharmacist gains experience interacting with a variety of patients, including pleasant and not so pleasant, cooperative and uncooperative, verbose and recalcitrant, and interested and disinterested patients.

Early in the interview, ask open-ended questions that allow patients to talk freely about their medications and concerns. This technique clues the patient that the pharmacist is interested in what he or she has to say and gives the pharmacist feedback regarding the patient's level of knowledge and ability to communicate this information. A good initial question for both acute care and chronic care patients is, "What medications are you currently taking?" Use minimal facilitators such as "yes," "uh huh," and "what else?" and provide nonverbal encouragement by smiling and nodding when appropriate. Give the patient time to answer. Some patients can provide well-organized and detailed information without much additional direction; however, other patients ramble and shift to nonrelated topics. Some patients cannot provide any information without specific targeted questions. Some patients have told their stories so many times that they automatically recite their stories or what they think the pharmacist wants to hear without focusing on the pharmacist's questions.

Ask directed and structured questions after the patient has presented his or her story or has begun to stray from the initial question. Narrow the focus of the question as appropriate. Discuss one topic at a time and avoid asking leading questions, multiple questions, and yes/no questions. Simple yes/no questions are useful screening questions but inhibit the patient's flow of information when used excessively.

Take time during the patient interaction to summarize the information provided by the patient. This lets the patient know what the pharmacist has learned, gives the pharmacist a chance to verify the information, and ensures that the patient and pharmacist are in agreement. Frequent summaries also let the pharmacist identify and correct any discrepancies in the patient's story.

Close the patient-pharmacist interaction by providing a final summary of the information obtained from the patient. Let the patient make any final clarifications or add additional information. End the interaction by thanking the patient pleasantly and saying "good-bye."

Patient Instruction

Pharmacists tend to consider the prescription label the primary communication tool between the pharmacist and the patient. However, optimal patient interaction requires more than this one-way communication mechanism. Several communication objectives for patient instruction have been identified,[4] including identification of the patient's needs, control of the timing and amount of information provided during each interaction, determination of patient-specific objectives, and assessment of patient learning. For example, the pharmacist cannot assume that asthmatic patients use metered-dose or dry-powder inhalers correctly or know how to monitor their lung function with a peak flow meter. Question such patients to determine their depth of knowledge and degree of understanding, then develop a plan for patient education. Plan to convey drug-specific information over several sessions and provide such patients with written information to reinforce the verbal information.

Assess patient needs in the context of the patient's emotional status, educational background, and intellectual ability. Some patients want to know everything about their medications. Other patients do not want to know anything. Balance the patient's desire for information with the need for information. At the end of the interaction determine the depth of the patient's learning and retention in a nonthreatening manner. Ask the patient to summarize or repeat the information discussed. Over time and through repeated interaction, the pharmacist can convey a large amount of drug-specific information and help the patient successfully manage the medication regimen.

Medical Jargon

Avoid medical jargon when communicating with patients. This can be challenging, but pharmacists must be able to translate commonly used pharmacy and medical terms into lay terminology. Results from a study evaluating patient understanding of commonly used pharmacy terms (Table 2-2) indicated that many patients

Table 2-2 Commonly Misunderstood Terms

Term	Meaning
Allergic	A response stimulated by an allergen
Antibiotic	A drug that inhibits the growth of microorganisms
Antihistamine	A medication that blocks the action of histamine
Controlled substance	A medication with addictive potential
Cough suppressant	A medication that reduces cough
Decongestant	A medication that reduces congestion
Diuretic	A medication that increases the amount of urine
Generic	The nonproprietary name for a medication
Hypertension	High arterial blood pressure
Inflammation	A complex pathologic process that affects blood vessels and tissues
Oral	Relating to the mouth
Over-the-counter (OTC) drugs	Nonprescription medications
Third-party payers	Organizations that pay health care bills

From Shaughnessy AF: Patients' understanding of selected pharmacy terms. *Am Pharm* NS28(10):38-42, 1988.

did not understand these terms; in fact, many patients interpreted these terms quite differently from the way in which they were intended.[5] For example, some patients thought the term *diuretic* meant a medication that was intended for diarrhea or concerned the diet or diabetes; some patients thought the term *generic* meant synthetic or not as good, or thought the term concerned the elderly.

Patients misinterpret even commonly used medical terms. For example the term *hypertension* has multiple meanings to patients. Some patients think it means hyperactive or nervous. Some cultures use the term *high blood* to indicate hypertension and *low blood* to indicate anemia. Some patients confuse *congestive heart failure* with *myocardial infarction*. Other commonly used medication-related terms such as *adverse reaction, divided dose, dosage, restart, intake, interaction, intermittent, intravenous, sublingual, subcutaneous,* and *topical* may not be understood.

The best way to avoid miscommunication and confusion is to speak in plain English and use concrete and specific references. Provide many opportunities for patients to ask questions. Be aware that some patients, especially those with chronic disease, frequent contacts with the health care system, or a health care background, may have sophisticated pharmacy and medical vocabularies and may be offended by the use of simplified lay terminology. Be especially sensitive to the needs of nonnative English speakers who may be confused by American slang or cultural references. The use of trained professional translators is associated with fewer communication errors, increased patient comprehension, improved clinical outcomes, and increased satisfaction.[6] Family members, especially small children, may filter as they translate, which results in transmission of incomplete information.

Special Situations

Pharmacists must be able to communicate with patients who are unable or unwilling to communicate in keeping with generally accepted dominant societal norms. The patient's situation or attitude may compromise communication. Some patients are so stressed by acute or chronic illnesses that they do not adhere to common rules of courtesy. Communication with such patients may be extremely difficult. Differences in cultural, social, and educational backgrounds may make communication between the patient and pharmacist difficult. The pharmacist, not the patient, is responsible for recognizing the special situation and having the skills and flexibility necessary to ensure appropriate and effective communication.

Antagonistic Patients. Antagonistic patients do not want to be bothered with medication histories, interviews, or other pharmacist-patient interactions. The natural response to these patients is to leave them alone and avoid them if possible or to become angry or patronizing. However, these patients deserve as much attention as other patients and may need more attention from the pharmacist because their behavior alienates them from other health care professionals. The best way to deal with such patients is to be as professional and direct as possible. These patients may be frightened or simply fed up with the entire health care system; therefore clarification of the purpose of and reasons for the interaction and the ways in which the information obtained from the interaction are used may be helpful. Most patients have great respect for pharmacists and cooperate if the need for the interaction is clearly defined and they perceive that they are treated with respect.

Chronically Ill Patients. Chronically ill patients present unique communication challenges. Chronically ill patients may be sophisticated and/or demanding health care consumers. Some chronically ill patients know more about the management of their disease than many health care professionals; this situation may be threatening for the pharmacist. Some chronically ill patients may be completely disillusioned by repeated unsatisfactory interactions with the health care system and may be bitter, cynical, and difficult to engage in conversation.

Chronically ill patients deserve the same amount of information and attention as all other patients. Assess the needs of each patient and be flexible enough to communicate on an appropriate level. Discussing sophisticated therapeutic regimens may be a pleasure with pleasant and well-informed patients but extremely difficult with bitter, cynical patients. Chronically ill patients must learn to live with their disease; this may take years and may never be fully accomplished.

Critically Ill Patients. The intensive care unit is a highly depersonalizing environment. Patients have little privacy or sense of control. Families and friends may feel overwhelmed. Patients are surrounded by high-tech equipment and may be sleep deprived, drowsy from pain medication, or uncomfortable from procedures, tests, or surgery. This environment makes it difficult to relate to the patient as a person. Nevertheless, it is important to communicate directly with the patient. Speak to the patient when entering or leaving the patient's room, even if the patient appears unresponsive. Never assume that the patient cannot hear or comprehend what is said in her or his presence. Make eye contact with the patient, even if it means getting very close to the patient's face. Endotracheal intubation renders patients mute, but do not assume that intubated patients cannot communicate. Intubated patients can respond to yes/no questions by blinking their eyes or raising an arm. Some intubated patients can express themselves in writing if the paper is positioned for them or can use point and spell boards. Acknowledge and communicate directly with the patient's family and friends, who may be very anxious or frustrated.

Culturally Diverse Patients. Pharmacists increasingly interact with culturally diverse patients who may not understand or accept dominant U.S. health care cultural beliefs about time, personal space, eye contact, cause of illness, the role of medications, spiritual roles, lines of authority and decision making, the role of nutrition, and the pathogenesis of disease. Respect the patient and do not impose U.S. health care cultural beliefs on the patient. Talk with the patient about his or her beliefs and work to integrate the patient's beliefs into the prescribed regimen. The Betancourt ESFT patient-based model provides a framework for pharmacists to interact with culturally diverse patients (Table 2-3).[7]

Table 2-3 Betancourt's ESFT Patient-Based Model

Component	Questions for Patients
*E*xplanatory	• What do you think caused your problem? • Why do you think it started when it did? • How does it affect you? • What worries you most? • What kind of treatment do you think you should receive?
*S*ocial	• How do you get your medications? • Are they difficult to afford? • Do you have time to pick them up? • How quickly do you get them? • Do you have help getting them?
*F*ears	• Are you concerned with the design, color, or size of the pills? • Have you heard anything about this medicine? • Are you worried about the side effects?
*T*reatment	• Do you understand how to take this medication? • Can you tell me how you will take it?

From Betancourt JR: Cultural competency: providing quality care to diverse populations. *Consult Pharm* 21:988-995, 2006.

Elderly Patients. Elderly patients have special needs.[8,9] Elderly patients may have impaired hearing and vision. The hearing loss associated with aging is characterized by loss of ability to distinguish between high-frequency sounds, which makes it difficult for patients to differentiate conversational tones from background noises. Visual changes associated with aging include loss of accommodation, cataracts, reduced peripheral vision, and problems distinguishing some colors. Elderly patients may be sensitive to harsh, glaring lights and highly reflective surfaces. They may not be able to read prescription labels and other printed material or distinguish among similarly shaped dosage formulations.

Take the time to engage elderly patients in unhurried conversation. Speak slowly and distinctly, and avoid youth-oriented vernacular or slang. Treat elderly patients with respect. Do not assume that every elderly person has impaired hearing. Speak directly to the patient and do not assume that the patient is incompetent or that the person accompanying the patient is a caregiver or guardian. Use large-print labels and printed materials and reinforce written information with verbal communication. Touching the patient lightly on the arm or shoulder may reassure the patient and reinforce the context of the conversation.

Patients in Embarrassing Situations. Most patients find discussions related to sex, intimate body parts, and bodily functions embarrassing (Box 2-3).[10] Many female community pharmacists have had the experience of watching men loiter in the pharmacy until they can ask a male clerk about condoms. Asking male pharmacists about the application of vaginal creams or suppositories embarrasses many female patients. Some patients are so embarrassed by such situations that they deliberately avoid asking for help, choosing to remain uninformed rather than risk the embarrassment (Figure 2-6).

Box 2-3 Potentially Embarrassing Situations

Asking about drug-induced sexual dysfunction
Asking for any of the following:
- Hemorrhoid products
- Enema supplies
- Douche supplies
- Ostomy supplies
- Birth control products

Discussing any of the following:
- Drug or substance abuse
- Alcoholism
- Obesity
- Illiteracy
- Constipation
- Diarrhea
- Incontinence
- Nonadherence

Figure 2-6 Embarrassing Situations.

To deal with these situations, be aware of what may be potentially embarrassing and be ready to bring up the subject if the patient has difficulty doing so. Converse with the patient in as private an environment as possible. Be sensitive to clues that suggest potential embarrassment and communicate with the patient in a respectful, professional manner.

Clues to a patient's embarrassment include avoidance of eye contact, blushing, stammering, closed body language, and excessive nervous small talk about unrelated matters (e.g., the weather, sports). Project a professional demeanor and put the patient at ease by discussing the issue in a straightforward, scientifically appropriate manner. Humor, although it may temporarily relieve tension, may make the patient more embarrassed and should be avoided. Use anatomically correct terms instead of slang. Give patients many opportunities to express their feelings.

Hard-to-Reach Patients. Hard-to-reach patients include those of low socioeconomic status, minorities, and illiterate persons.[11] Communicating with these patients may be difficult. Patients of low socioeconomic status have few resources to deal with health care issues. They may have little knowledge about health care in general and their own health in particular and may have different coping mechanisms and expectations. They may not have the economic or social resources to participate in preventive health care or manage acute or chronic illness. Pharmacists must be sensitive to these issues.

Look beyond these issues and communicate clearly and directly with each patient as an individual, regardless of the patient's status. Hard-to-reach patients deserve as much respect, time, and information as do all other patients and should not be glossed over and dismissed because of their socioeconomic status, ethnic origin, or illiteracy. The health care needs of hard-to-reach patients often are greater than those of other patients; be sensitive to their needs. Help illiterate patients organize complex medication regimens by using different-sized bottles for each medication or color-coding the labels. The use of calendars with dosages of unit-of-use medication stapled to the appropriate date may help illiterate patents adhere to complex medication regimens. Other medication-delivery devices may help patients keep track of their doses.

Be sensitive to the cost of medications and the ability of the patient to pay for the medication. Low-income elderly patients in particular may be too embarrassed to ask about the cost of medications and may accept expensive medications they cannot afford. Less expensive, therapeutically acceptable alternative medications usually are available. Some pharmaceutical companies have patient assistance programs that provide select medications free of charge to individuals who do not have third-party prescription coverage and who meet specific income requirements. Some large chain pharmacies have programs that supply low-cost 30-day and 90-day generic medications for select medications.

Hearing Impaired Patients. Be sensitive to the potential for patients to have hearing impairment. Do not assume that all people with hearing impairment can read lips or understand American Sign Language (ASL); also do not assume that a hearing aid returns the patient's hearing to normal. Do not assume that hearing impaired patients have diminished intellectual abilities.

Many pharmacists are quite skilled in ASL, used by deaf individuals in the United States and deaf English-speaking Canadians, or they can finger-spell words using the ASL alphabet. ASL courses and seminars are widely available. Regardless of the level of special skills obtained, communicate as clearly as possible with hearing impaired patients. Verbalize slowly and distinctly; minimize background noise. Face patients who can read lips and avoid turning away from the patients during the conversation. Written communication may be necessary for two-way communication.

Mentally Retarded Patients. Communicate clearly and directly with mentally retarded patients and do not assume that the patients are incapable of participating in their health care. Look beyond the disability and deal directly with the patient. However, communicate clearly and directly with the patient's caregiver. Many degrees of mental retardation are possible; be flexible enough to assess the level to which each patient can participate and communicate appropriately for each situation.

Mute Patients. Muteness from endotracheal intubation, tracheostomy, or damage to the vocal cords or trachea from disease or trauma can be extremely frustrating for patients. The situation can be equally frustrating for pharmacists, who rely on verbal information from patients when obtaining patient data and monitoring response to therapy. Written communication and the use of point-and-spell letter boards can be time consuming but often are the only means for two-way communication. Encourage these techniques and allow sufficient time for adequate communication. In addition, maintain your end of the conversation and do not limit your verbal responses just because the patient is mute.

Noncommunicative and Overly Communicative Patients. Noncommunicative and overly communicative patients present special challenges. Noncommunicative patients never volunteer information or express much interest in anything anyone has to say. These patients answer all questions with unenthusiastic yes/no responses. To facilitate communication, get the patient talking about any topic and then ask simple, open-ended questions that will provide at least some of the information being sought during the interaction. For example, patients unwilling to identify the medications they are currently taking may open up and start discussing their medication if asked to describe their satisfaction with past medication. Sometimes no communication method works, and the communication remains one way. However, most patients can be drawn out and encouraged to engage in effective two-way communication.

Overly communicative patients digress when asked even simple direct questions. Pharmacists eventually obtain the information being sought, but only after investing a lot of time in the interview. The best way to deal with this type of patient is to take firm control of the conversation from the start and redirect the patient when he or she wanders off the subject. The patient may have to be allowed to wander a little before being gently but firmly interrupted and redirected. For example, a patient may be eager to discuss a pet dog's medical problems. The pharmacist may need to give the patient a few moments to talk about these issues before redirecting the patient back to the focus of the interview.

Pediatric Patients. Communicate directly with the pediatric patient as well as with the parent or guardian; do not assume that children have nothing to contribute to their health care. Even young children can understand why they are taking a medication and can begin to develop a professional relationship with the pharmacist. However, information must be age appropriate. For example, communication with young children may be as simple as telling them why they are going to take the medication (e.g., "This medication will help you breathe better"). In-depth information exchange is appropriate for many preteens and teenagers. Direct communication with preteens and teenagers who have chronic disease for which they follow long-term medication regimens is especially important. Preteens and teenagers exert considerable control over their lives and need to understand how to use their medications.

Physically Challenged Patients. Physically challenged patients often have to deal with multiple communication barriers.[12] Pharmacists, like most members of society,

often have a hard time focusing on the person in the wheelchair or seeing the patient behind the prosthetic device. Many people falsely assume that physical disabilities are linked with mental disabilities. Not only do these perceptual difficulties arise, but some physical disabilities leave the patient with limited or garbled speech, which makes it difficult for the patient to express himself or herself. Other disabilities impair a patient's vision or hearing.

Communicating with physically challenged patients is no different than communicating with physically able patients. Engage the patient in unhurried conversation and give the patient ample time to respond. Speak directly to the patient and do not assume that the patient is incompetent. Do not assume that the person accompanying the patient is the patient's caregiver. Do not stare at the patient or avoid eye contact and do not physically assist the patient (e.g., push a wheelchair, guide a blind patient) unless invited to do so by the patient.

Terminally Ill Patients. Terminally ill patients may be sophisticated and/or demanding health care consumers; they also may be bitter, cynical, and difficult to engage in conversation. Terminally ill patients often are on complicated drug regimens requiring detailed instruction and monitoring. Many terminally ill patients and their families have to deal with the stigma of filling frequent prescriptions for high-dose narcotics.

Treat terminally ill patients with respect and work with them to achieve optimal therapeutic efficacy within the complexities of their illnesses and the health care environment. Terminally ill patients may need help dealing with complex insurance paperwork and complex medication regimens. Terminally ill patients need close monitoring and reassurance about their medication regimens. Some terminally ill patients require large and frequent doses of narcotics; work with the patient and the patient's family to legitimize the use of these medications and minimize the hassles associated with obtaining narcotics.

COMMUNICATING WITH HEALTH CARE PROFESSIONALS

Effective communication between pharmacists and physicians, nurses, and other pharmacists is essential. Poor communication not only leads to frustration and lack of respect among professions but also may compromise patient care if important information is misunderstood, ineffectively conveyed, or left out.

Pharmacist-Physician Communication

Pharmacists and physicians often have trouble communicating with one another. Both professionals are extremely busy; communication usually takes place when neither party has much time to converse. Many pharmacists are intimidated by physicians (Figure 2-7). To communicate effectively, pharmacists must be comfortable with their role on the health care team and confident in their unique knowledge and contributions to patient care.

Be prepared with specific questions or facts and recommendations when initiating a patient care–related conversation with physicians. Make sure other resources cannot answer the question. Stay within the pharmacist's area of expertise. Choose the right time and place for the conversation. Never interrupt a physician-patient interaction,

Figure 2-7 Pharmacist-Physician Communication.

except in a life-threatening situation. Follow the chain of command. Do not go to an attending physician when the question or recommendation is more appropriate for a less senior member of the medical team. Do not interrupt teaching rounds with trivial questions and observations better communicated one to one with individual physicians. Do not engage physicians in lengthy social small talk.

If the physician initiates the conversation, listen carefully, assess the information or question, and ask for additional information until the question is clear and specific. Physician-initiated questions often are vague and general. Clarify the question and obtain appropriate patient-related data. For example, a physician may ask if a serum digoxin concentration of 0.8 ng/mL is okay. Given that the usual therapeutic range is 0.8 to 2.0 ng/mL, the initial reaction is to confirm that a concentration of 0.8 ng/mL is okay. However, the question should not be answered until the pharmacist finds out why the drug was prescribed (i.e., for heart failure or for atrial fibrillation), when drug therapy was initiated, when the blood sample was obtained, what the clinical status of the patient is, and what is the goal of therapy.

Pharmacist-Nurse Communication

Pharmacists and nurses also often have trouble communicating with one another. Pharmacists and nurses are extremely busy; communication often occurs when neither party has much time to spend talking. Unfortunately in the acute care setting most pharmacist-nurse communication takes place because of drug distribution errors; much of the tension between the two professions is based on these interactions. Nurses are pressed to obtain and administer medication and pharmacists are frustrated because nonstat requests often are presented as emergencies (e.g., stat docusate sodium). The pharmacist and the nurse end up in a tug-of-war over work priorities, which can lead to lack of respect and poor communication on the part of both professionals. Pharmacists and nurses must treat one another with respect; both professionals must realize that they share the same goal (e.g., optimal patient care) and are on the same patient care team. Communication should be clear, to the point, and timely.

An added barrier to effective pharmacist-nurse communication is the use of the telephone as the primary means of communication. It is easy to be rude, either intentionally or unintentionally, during telephone conversations. Feelings are hurt and reputations lost when tempers flare during less than optimal telephone interactions.

Pharmacist-Pharmacist Communication

Patient care may be less than optimal because of communication difficulties between pharmacists. For example, pharmacists on hospital-based consult services such as pharmacokinetics or infectious disease may not have access to recent uncharted patient information or be privy to in-depth discussions during team rounds. Pharmacists on the patient care team need to update consulting pharmacists frequently. Consulting pharmacists should be aware that the primary team may have more information than that documented in the patient record; they should not make recommendations in isolation.

Inpatient patient-focused care takes place 24 hours a day, 7 days a week. Continuity between shifts requires clear communication of patient information, plans for the patient, and other patient issues. A common communication system is the exchange of patient information during sign-out rounds or the discussion of patient-specific issues and the passing on of patient monitoring forms and other types of written documentation between the pharmacist leaving the service and the pharmacist assuming responsibility for the patient.

Community pharmacists and institutional pharmacists rarely share patient-related information. Although patients and other members of the health care team potentially benefit by knowing details regarding patient medications and status before hospitalization and upon discharge, the fragmented nature of traditional health care delivery systems makes this type of communication nearly impossible. Unified health care delivery systems may allow for more information to be communicated among pharmacists as the patient moves between ambulatory and acute care environments.

TELECOMMUNICATION

Rapidly evolving communication technologies are enabling new and increasingly sophisticated means of communication between patients and health care professionals and between members of the health care team. Email, text messages, and faxes are accepted communication tools; communication with patients and health care professionals via social media is becoming more common.

The field of telecommunication is rapidly evolving. The prefix "tele-," meaning "distant," has now been incorporated into a growing list of medical terms (Box 2-4). The term *telehealth* is a broad umbrella term that includes distant clinical and nonclinical services. The term *telemedicine* is defined as "the use of telecommunications technologies to provide medical information and services," although it is generally used to refer to remote electronic clinical consultation.[13] Most telemedicine technologies use either *store and forward* applications or *two-way interactive television* (IATV) applications. With store and forward technology, digital images (e.g., radiology, dermatology, pathology images) are created in one location and then sent to another often distant location. IATV is used to enable face-to-face consultations, often between an on-site health care professional and a distant specialist. Other telecommunications applications include remote patient monitoring, health care professional education, and consumer education. Devices such as electronic stethoscopes, glucometers, respirometers, pulse oximeters, and vital sign sensors enable a wide range of home telemonitoring for patients with chronic diseases.[14]

Box 2-4 "Tele-" Medical Terms

Telecare
Telecardiology
Teleconsulting
Teledentistry
Teledermatology
Telehealth
Telemedicine
Telemonitoring
Teleneurology
Teleophthalmology
Telepathology
Teleproctoring
Telepsychiatry
Telerehabilitation
Telesurgery
Teletransmission

Pharmacists using these new telecommunication tools to communicate with patients and health care professionals need to respect the patient's right to privacy by knowing and adhering to Health Insurance Portability and Accountability Act of 1996 (HIPAA)[15] and Internet access policies. The easy access to patients and other health care professionals tends to make the communication seem less formal, but communication should remain professional and respectful at all times.

ADDITIONAL COMMUNICATION SKILLS

TEACHING

Many pharmacists teach in a variety of settings, including one-on-one individualized patient teaching, small-group patient support groups, and seminars and lectures for pharmacy and other health care students. Community, institutional, and industry pharmacists may have a variety of classroom teaching responsibilities at nearby colleges of pharmacy, nursing, or medicine (e.g., lectures, recitations, laboratories). Although many pharmacists teach, most have little formal training in teaching.

An effective teacher is well organized, is knowledgeable about the subject being taught, and has excellent communication skills. Communication is enhanced by good organizational skills. The structure of the session and material should be obvious without the use of written handouts. Introduce topics and summarize periodically. Interact with the audience during the teaching

session to determine the depth of the participants' understanding and change or redirect the focus of the lecture or discussion to meet the needs of the audience. Direct questioning and assessment of responses are easy ways to determine whether the students and participants understand the material; however, these methods are less effective in large classroom settings. Active learning, even in large classes, enhances the learning experience. Feedback in formal classroom settings comes primarily from nonverbal behavior. Participants who understand and comprehend the material are quiet, focused, and obviously thinking. Participants who are confused or do not understand the material being presented shift uneasily in their seats, converse with those around them, engage in other activities (e.g., reading a newspaper), or sleep.

Pharmacy clerkships typically consist of one-on-one or small-group teaching sessions. The student and teacher review individual patient cases and discuss the pathophysiology and therapeutic issues. Many students are intimidated by the highly individualized nature of this type of one-on-one teaching. Put the student at ease while controlling the educational aspect of the interactions. Students also may feel intimidated or threatened by a constant barrage of seemingly unrelated questions. An effective communication tool during these types of teaching sessions is the circular questioning technique. This technique involves guiding the student through a series of related, basic questions that eventually lead the student to discover the correct answer to a previously asked question. Then ask a series of increasingly difficult questions, which allows the student to reinforce the material already learned while applying and learning new information. Frequent verbal summaries and constructive feedback are essential teaching tools.

PLATFORM AND POSTER PRESENTATIONS

Platform Presentations

Many pharmacists give platform presentations at local, state, and national professional meetings (Figure 2-8). However, most pharmacists have little experience with these types of presentations. Audiences range from fewer than a dozen to several hundred people and include pharmacists as well as other health care professionals. Many pharmacists are stressed by public speaking. Although the degree of stress felt by the speaker depends on the individual and the specific situation, some degree of stress is perfectly natural. Stress is reduced through experience and thorough preparation. However, many experienced speakers still admit to being nervous before and during presentations. Some speakers find they can reduce stress by acknowledging the anxiety rather than denying their feelings. The nervous energy generated by stress can be directed into enthusiasm for the topic and increased energy during the presentation.

Reduce stress by selecting an appropriate topic. Speaking about a familiar topic is much easier than speaking about a less familiar topic. Be well informed and well prepared. Minimize stress by considering the audience and targeting the level of information to the audience's background. This helps create interest on the part of the audience, which in turn provides positive feedback to the speaker. Learn how to operate all the audiovisual equipment you wish to use before starting the presentation.

Figure 2-8 Platform Presentations. Many pharmacists present at local, state, and national professional meetings. (Jupiter Images)

Box 2-5 Slide Design

Use simple font styles.
Limit each slide to one idea, figure, or table.
Use a horizontal rather than a vertical format.
Use no more than five or six lines per slide.
Use a 2:3 horizontal/vertical ratio for each slide.
Use colors to highlight information, but do not use more than two or three colors.
Use bright, clear colors; avoid pastels and neon colors.
Use simple tables and graphs.

Box 2-6 Transparency Design

Use simple font styles.
Use letters large enough to be read from a distance.
Limit each transparency to one idea, figure, or table.
Use no more than five or six words per line.
Use no more than five or six lines per transparency.

Reduce the stress of answering audience questions by anticipating and preparing answers to likely questions.

Use appropriate audiovisual materials. A good visual image presents information more vividly and accurately than lengthy verbal descriptions. For example, a videotape of a patient having a grand mal seizure provides visual images that cannot be obtained from oral descriptions. Create well-designed slides (Box 2-5), transparencies (Box 2-6), and audio and video clips. Currently available computer programs allow the creation of sophisticated images and integration of multiple audiovisual formats. Design visual images to enhance rather than replace orally presented information. Design the images so that all members of the audience can see the images and read all the information presented.

Poster Presentations

The poster presentation is a unique communication format in which the information is displayed visually rather than presented orally (Figure 2-9). Although most poster sessions require the author to be available to answer questions and discuss the information presented, the visual

Figure 2-9 Poster Presentations. The poster presentation is a unique communication format in which information is displayed visually.

image of the poster is what grabs the attention of passersby and draws them in for more detailed perusal. Posters that attract the most attention have clear, descriptive titles and a colorful, neat, and professional appearance.

The allocated space dictates the amount of information presented on the poster. The amount of space allocated for each poster varies from meeting to meeting; requirements and limitations are communicated to the presenter when the poster is accepted for presentation. Most posters include a descriptive title, names of the individuals presenting the data, abstract, introduction, background information, study design, data, results, and conclusions. Printed material should be readable from several feet away. Brightly colored backgrounds enhance the visual presentation. Visual aids such as tables, graphs, charts, and photographs communicate information more effectively than multiple pages of text.

MEDIA INTERVIEWS

Pharmacists may be called by the media to provide background information and commentary regarding therapeutic issues such as the marketing of an important new drug, a widely publicized drug-related problem, or the withdrawal of a drug from the market. Media interviews can be interesting and rewarding experiences that provide a positive and effective form of communication between pharmacists and the public. However, pharmacists need to remember that journalists are not health care professionals and may misunderstand or use information out of context. Be cognizant of the very short deadlines most journalists have to meet; journalists may need information for a news report scheduled to air in just a few hours. Journalists can be quite aggressive. A media expert noted, "If you don't learn to use the media to your advantage, you will be used by it."[16]

Most media contact is by telephone. Determine the contact's name, telephone number or email address, organization, position, the way in which the information is going to be used, and the exact issues of interest. Do not answer any questions, divulge any information, or provide any opinions without knowing this information. Some members of the less-than-reputable media do not offer this information unless specifically prompted. Members of the legitimate media understand the importance of this information and readily disclose these facts.

Prepare to speak with a journalist by reviewing the subject to be discussed. Anticipate related or tangential issues and be prepared to elaborate on the topic and to explain technical terminology and concepts in lay language. Speak with other individuals who have been interviewed by the reporter or read articles published by the journalist to get a feel for the person's style. After the interview, ensure that the information obtained by the journalist is accurate. No one wants to be misquoted or quoted out of context. Be available for clarification by telephone, fax, or email. Some print-format publishers ask sources to review and verify the information before publication.

NEWSLETTERS AND MANUSCRIPTS

Pharmacists may write articles for or serve as the editor of patient- or health care professional–oriented newsletters (e.g., pharmacy and therapeutics committee newsletters). Original research reports, case studies, review articles, editorials, and letters to the editor are important communication tools among health care professionals worldwide. Publishing these types of articles in the print and electronic media is an important but challenging activity. Successful publication requires excellent writing skills as well as careful planning and execution of the plan.

One of the most important issues when attempting to publish a manuscript is selecting the appropriate journal. Match the focus and type of manuscript with the focus and audience of the journal. For example, editors of the *Journal of Infectious Diseases* are not interested in publishing a manuscript about a drug used to treat gastrointestinal bleeding. Other common mistakes include trying to publish information already well documented in the literature, submitting a report of a poorly designed and/or executed study, submitting a poorly written manuscript, and not following journal-specific guidelines. Well-written manuscripts that meet the needs of the journal's audience will be published.

APPLICATION ACTIVITIES

Activity 2-1

One-Way and Two-Way Communication

The goal of this activity is to reproduce a complex diagram described through verbal communication. This activity is best carried out by pairs of individuals.

One-Way Communication Exercise

Position yourselves so that you are sitting back to back and cannot see each other's faces. One person (the sender) gives verbal instructions to the other person (the receiver) describing the diagram (diagram no. 1), and the receiver attempts to draw it. Only the sender is allowed to speak; no other type of communication is permitted. Once the sender is through describing the diagram, look at the diagram and see how accurately the receiver reproduced the diagram. Then discuss the following questions:

- How did the sender feel during the exercise?
- How did the receiver feel during the exercise? How effective was the one-way communication (was the diagram reproduced accurately)?
- What are the problems associated with one-way verbal communication?

Two-Way Communication Exercise

Position yourselves so that you are sitting back to back and cannot see each other's faces. One person (the sender) gives verbal instructions to the other person (the receiver), describing the diagram (diagram no. 2), and the receiver attempts to draw it. Both the sender and receiver may ask and answer questions, but no other type of communication is permitted. Once the sender is through describing the diagram, look at the diagram and see how accurately the receiver reproduced the diagram. Then discuss the following questions:

- How did the sender feel during the exercise?
- How did the receiver feel during the exercise?
- How effective was the communication (was the diagram reproduced accurately)?
- Whataretheadvantagesoftwo-wayverbalcommunication compared with one-way verbal communication?

Diagram 1

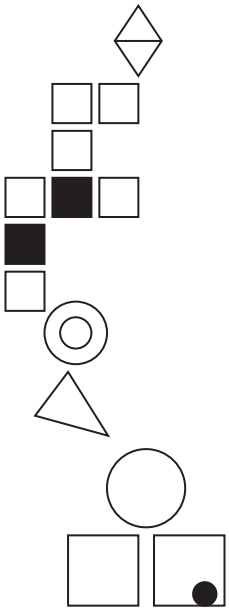
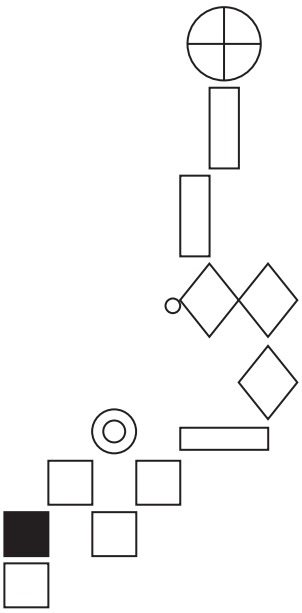


Diagram 2



Activity 2-2

Patient Communication

The goal of this activity is to explore communication strategies for patients with a variety of special needs. This activity is best performed in small groups (four or five people).

As a group, identify the barriers to communicating with each of the following patients: a blind patient, a hearing impaired patient, a mute patient, an angry patient, and an undereducated patient (dropped out of school after the third grade). Brainstorm ways to overcome the barriers. Select one person to play the role of each patient. Using the methods you identified for overcoming the barrier, counsel the patient (see scenario below). As a group, assess the effectiveness of the patient interaction.

Scenario: The patient is to take two new medications (alendronate [Fosamax] and calcium carbonate). The alendronate is in a small prescription bottle and the calcium carbonate is in a large nonprescription bottle.

- Alendronate 70 mg (small white tablet). Take one tablet once a week to treat osteoporosis. Take the alendronate at least 30 minutes before the first food, beverage, or medication of the day but with plain water only. Take the alendronate with a full glass of water (6 to 8 oz) and do not lie down for at least 30 minutes after taking the alendronate.
- Calcium carbonate 500 mg (green oblong tablet). Take one tablet three times a day with meals to treat osteoporosis.

SELF-ASSESSMENT QUESTIONS

1. Active listening consists of which of the following actions?
   a. Focusing on what the other person says
   b. Assessing the way the other person communicates
   c. Conveying an open, relaxed, and unhurried attitude
   d. All of the above
   e. None of the above
2. To convey interest and attentiveness, the pharmacist should do which of the following?
   a. Avoid eye contact
   b. Stand or sit at eye level or lower
   c. Stand or sit as close to the person as possible
   d. Ignore the other person's body language
   e. Take copious notes during the interview
3. Barriers to verbal communication are minimized in which of the following settings?
   a. The interview takes place through a window with security bars.
   b. The interview takes place in front of three of the patient's hospital roommates.
   c. The interview is conducted over the telephone.
   d. The patient is interviewed in a private consultation office.
   e. The patient is interviewed through a drive-in window.

4. Which one of the following is *not* an important consideration when writing medical record notes?
   a. Use black ink.
   b. Write clearly and legibly.
   c. Title the note with a specific heading.
   d. Document the facts and avoid unsubstantiated judgments.
   e. Begin the note on an unused page.
5. When is addressing a patient by the first name appropriate?
   a. When a patient is disoriented
   b. When meeting a patient for the first time
   c. When trying to placate a patient
   d. When a patient is much older than the pharmacist
   e. When a patient is much younger than the pharmacist
6. What kind of questions should be asked early in a patient interview?
   a. Long, complex questions
   b. Questions that can be answered yes or no
   c. Open-ended questions
   d. Leading questions
   e. Multiple questions
7. Which of the following may make an embarrassing situation worse?
   a. Being aware of potentially embarrassing situations
   b. Being sensitive to clues that the patient is embarrassed
   c. Using humor to relieve the tension
   d. Discussing the issue in a scientifically appropriate manner
   e. Communicating with the patient in privacy
8. The best way to deal with antagonistic patients is to do which of the following?
   a. Avoid them
   b. Suggest less expensive alternative medications
   c. Talk with their legal guardians
   d. Speak slowly and distinctly
   e. Limit the length of each interaction
9. The best way to deal with physically challenged patients is to do which of the following?
   a. Treat them like any other patient
   b. Avoid making eye contact
   c. Stare at them
   d. Ignore them
   e. Physically assist them without asking permission
10. Cultural differences may occur between the U.S. health care system and other cultures in which of the following?
    a. Time perception
    b. Eye contact
    c. Role of medications
    d. All of the above
    e. None of the above
11. The prefix "tele-" refers to which of the following?
    a. Distant
    b. Computer
    c. Record
    d. Electronic
    e. Confidential
12. Stress associated with platform presentations can be reduced by doing which of the following?
    a. Targeting the material for the specific audience
    b. Acknowledging the presentation as a stressful situation
    c. Anticipating and preparing for audience questions
    d. All of the above
    e. None of the above

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http://evolve.elsevier.com/Tietze

Audio glossary terms

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CHAPTER

3 Taking Medication Histories

LEARNING OBJECTIVES

- State the advantages and disadvantages of interviewing patients before and after review of patient information.
- Define medication reconciliation and describe the role of the medication history in the medication reconciliation process.
- Identify relevant information obtained from observing the patient's appearance and environment.
- List the categories of data obtained during a medication history interview.
- Describe the type of information included in each category of data obtained during a medication history interview.
- Express a patient's smoking history in terms of pack-years.
- Differentiate between an allergy and an adverse drug reaction.
- State how to assess patient adherence to prescribed or recommended medication regimens.
- Identify types of questions to avoid when interviewing patients.
- Identify types of patients who are difficult to interview. Describe the most effective ways to interview these types of patients.
- Discuss the advantages and disadvantages of documenting the patient medication history using a standardized form, the SOAP (*S*ubjective, *O*bjective, *A*ssessment, *P*lan) format, and the freestyle format.

Historically, pharmacists relied on other health care professionals to obtain and document information regarding medications taken by patients. Many medications in the early twentieth century were relatively ineffective and had few known risks, so most health care professionals had little interest in or need for detailed medication histories. Pharmacists had limited direct patient care responsibility and did not need firsthand knowledge of patient medication use. Today, the medication history is the foundation for planning optimal patient-specific medication regimens. The medication history is the starting point for generating hypotheses regarding the patient's understanding of the role of medications in the treatment of disease; the patient's ability to comply with the medication regimen; the medication's effectiveness; and the patient's experiences with side effects, allergies, and adverse drug reactions. Pharmacists have a unique combination of drug-related expertise and experience; patients trust and respect pharmacists. Although other health care professionals interview patients regarding their use of medications, no other health care professional has the pharmacist's depth and scope of knowledge regarding medications. Therefore it is important that pharmacists obtain and document patient medication histories and communicate this information to the rest of the health care team.

Medication histories obtained by health care professionals other than pharmacists often lack important information regarding medication allergies and sensitivities, prescription and nonprescription medication use, use of alternative remedies, immunizations, and reliability in taking scheduled doses.[1-5] A meta-analysis of 22 studies of physician-obtained hospital admission medication histories found that 10% to 67% of the medication histories had at least one prescription medication error; the error rate when nonprescription drugs were included ranged from 27% to 83%, and the error rate when drug allergies or prior adverse reactions were included ranged from 34% to 95%.[4] Incomplete or incorrect admission medication histories may put the patient at risk due to interrupted therapy, unnecessary therapy, duplicative therapy, or incorrect therapy (inappropriately low or high dosages). Recognition of the increasing availability of potent prescription and nonprescription medications and the increasing fragmentation of the health care system has renewed interest in the need for pharmacist-acquired and pharmacist-documented medication histories.

For hospitalized patients, the medication history is the first step in the medication reconciliation process. In 2005 the Joint Commission released a new medication reconciliation National Patient Safety Goal (NPSG) (Goal 8) (Box 3-1).[6] Medication reconciliation, the process of comparing the patient's preadmission medications with the medications prescribed during the hospitalization, is intended to prevent medication-related patient safety problems such as errors of omission and duplication as well as drug-drug and drug-disease interaction errors. Successful medication reconciliation depends on obtaining an accurate and complete medication history at the time of admission to the hospital. Medication reconciliation, a complex and challenging process, is intended to improve patient safety while the patient is hospitalized and at

Box 3-1 National Patient Safety Goal 8, 2005 (The Joint Commission)

8A. During 2005, for implementation by January 2006, develop a process for obtaining and documenting a complete list of the patient's current medications upon the patient's admission to the organization and with the involvement of the patient. This process includes a comparison of the medications the organization provides to those on the list.

8B. A complete list of the patient's medications is communicated to the next provider of service when it refers or transfers a patient to another setting, service, practitioner or level of care within or outside the organization.

From National Patient Safety Goals. 2005 Hospital National Patient Safety Goals. Available at: http://www.jointcommission.org/PatientSafety/NationalPatientSafetyGoals/05_hap_npsgs. Accessed November 4, 2009.

Box 3-2 Patient-Oriented Process Skills

1. Knock on the door and request permission to enter the room of the institutionalized patient.
2. Introduce yourself.
3. Try to achieve privacy.
4. Make sure the patient is comfortable.
5. Communicate at eye level or lower.
6. Remove distractions (loud television, radio, relatives, and friends).
7. Clarify the purpose of the interview.
8. Obtain the patient's permission for the interview.
9. Verify the patient's name and correct pronunciation.
10. Address the patient by the appropriate title.
11. Maintain eye contact with the patient.

Adapted from Zakus GE, Hutter MJ, Dungy C, et al: Teaching interviewing for pediatrics. *J Med Ed* 51:325-331, 1976; Lipkin M Jr, Quill TE, Napodano RJ: The medical interview: a core curriculum for residencies in internal medicine. *Ann Intern Med* 100:277-284, 1984; Preven D, Kachur EK, Kupfer RB, et al: Interviewing skills of first-year medical students. *J Med Ed* 61:842-844, 1986.

discharge. Many institutions have developed pharmacist-based medication reconciliation processes.

Obtaining medication histories is not just a matter of common sense and experience. Although interviewing is a creative process that is somewhat difficult to define, successful interviewing requires excellent patient-oriented process skills (Box 3-2) and communication process skills (Box 3-3). Pharmacists also must be aware of and avoid common hindering behaviors (Box 3-4).[7-9] The patient questions should be more general initially, then become more focused as the pharmacist obtains the necessary details (Box 3-5). Ask open-ended questions at the start of the interview and then move to more direct and targeted questions as the interview proceeds. For example, a good opening question is to ask the patient to describe any medications taken daily. This question allows the patient to discuss his or her medication routines and provides the pharmacist with clues regarding lines of targeted questioning to be pursued later in the interview. An

Box 3-3 Communication Skills

1. Provide clear instructions regarding the structure of the interview and expectations for the patient.
2. Use a balance of open-ended and closed-ended questions.
3. Use vocabulary geared to the patient.
4. Use nonbiased questions.
5. Give the patient time to respond.
6. Interrupt or redirect as necessary but do not interrupt when the patient is on track.
7. Listen to the patient; do not cut off the patient.
8. Discuss one topic at a time.
9. Move from general to specific topics.
10. Pursue unclear answers to questions until they are clarified.
11. Ask simple questions.
12. Identify and recognize patient feelings. Verbally acknowledge inappropriate or hostile feelings.
13. Give feedback to the patient. Ask, "Is this what you mean?"
14. Obtain feedback from the patient.
15. Attend to patient cues (posture, tone of voice, affect).
16. Invite the patient to ask questions.
17. Answer patient questions.
18. Use transitional statements and summarization.
19. Close the interview.

Adapted from Zakus GE, Hutter MJ, Dungy C, et al: Teaching interviewing for pediatrics. *J Med Ed* 51:325-331, 1976; Lipkin M Jr, Quill TE, Napodano RJ: The medical interview: a core curriculum for residencies in internal medicine. *Ann Intern Med* 100:277-284, 1984; Preven D, Kachur EK, Kupfer RB, et al: Interviewing skills of first-year medical students. *J Med Ed* 61:842-844, 1986.

Box 3-4 Hindering Behaviors

Using technical language and medical jargon
Frequently interrupting the patient
Asking leading questions
Allowing frequent interruptions (phone calls, beepers)
Expressing bias and personal prejudices
Maintaining a closed posture
Reading notes and charts during the interview
Adopting a superior or threatening posture
Avoiding eye contact with the patient
Engaging in sarcasm
Making derogatory statements about other health care professionals
Ignoring emotion displayed by the patient
Speaking too quickly or too slowly or mumbling
Asking multiple questions
Asking rapid-fire questions
Perpetuating cultural barriers

Adapted from Zakus GE, Hutter MJ, Dungy C, et al: Teaching interviewing for pediatrics. *J Med Ed* 51:325-331, 1976; Lipkin M Jr, Quill TE, Napodano RJ: The medical interview: a core curriculum for residencies in internal medicine. *Ann Intern Med* 100:277-284, 1984; Preven D, Kachur EK, Kupfer RB, et al: Interviewing skills of first-year medical students, *J Med Ed* 61:842-844, 1986.

Box 3-5 Sample Interview Questions

GENERAL QUESTIONS

Do you take any prescription medications?
What prescription medications are you taking?
Do you take any nonprescription medications (medications that you can buy without a prescription)? If so, what nonprescription medications are you taking?
Do you take any complementary and alternative medicines (for example, herbal supplements)? If so, what complementary and alternative medicines are you taking?
Are you allergic to any medication?
Have you ever had trouble breathing or had a rash after taking a medication?
Have you ever had any bad reactions to a medication? If so, can you describe what happened?
Can you describe your routine for taking your medications?

TARGETED QUESTIONS

Have you ever taken any other prescription medications?
Have you ever taken any other nonprescription medications?
Have you ever taken any other complementary and alternative medicines?
When did you start taking the medication?
When did you stop taking the medication?
When did you find out you were allergic to the medication?
What did you do when you had the allergic reaction to the medication?
Did you take any medication to treat the allergic reaction?
Where do you get your medications?
Do you ever miss any doses of your medications?
Do you ever take more or less than the prescribed dose of your medications?
Can you show me how you use your inhaler?
When did you start smoking?
How many packs per day do you smoke?
When did you stop smoking?
When did you start drinking alcohol?
What type of alcohol do you drink?
How many alcoholic drinks do you drink in a typical week?
When did you start using marijuana?
How much marijuana do you smoke in a typical week?

example of a more direct and targeted question is to ask the patient to describe the size, shape, and color of the medication regularly taken. Every patient is different, so be flexible and guide the patient through the interview.

Avoid asking leading questions, multiple questions, and excessive yes/no questions. A leading question such as "Does your tuberculosis medication turn your urine red?" may make the patient think the medication is supposed to turn the urine red and that something is wrong with the patient if his or her urine is not red. Probe for medication-related effects by asking more general questions, such as "How are you tolerating your tuberculosis medications? Have you noticed anything different or unusual since you started taking the medication?" Avoid the trap of asking a series of rapid-fire questions without giving the patient time to answer. Give the patient ample time to address each question before asking another question. Getting into a pattern of asking a series of yes/no questions also is very easy, especially toward the end of the interview, when the pharmacist asks specific and targeted questions. Such a series might include questions like "Do you take anything for headache? Do you take anything for your eyes? Do you take anything for your heart? Do you take anything for your breathing? Do you take anything when you have a cold? Have you ever taken penicillin?" This type of rapid-fire yes/no questions creates one-sided conversations and may diminish the flow of information from patients. Encourage patients to talk about their experiences with medications.

PREPARATION FOR THE INTERVIEW

There are two distinctly different approaches to preparing for a patient interview. One approach is to review all that is known about the patient's medical condition and medications and then target the interview to specific issues identified during the review. This approach is commonly used when patients are admitted to acute care or long-term care institutions where physicians and nurses have already documented at least some patient information. The advantages of this approach are that the pharmacist has some knowledge of the patient before the interview and can prepare to explore and address specific issues; the pharmacist may feel more comfortable having this knowledge before interacting with the patient. The interview may be more fluid with fewer gaps to fill in, and the pharmacist may be better prepared to deal with provider safety issues (e.g., ways to cope with a potentially violent patient, the need for contact precautions, etc.). The disadvantage of this approach is that important information may be overlooked if the pharmacist becomes too focused or unduly influenced by previously obtained information.

The other approach is to interview the patient before reviewing any previously documented patient information. Community-based pharmacists rarely have access to information about patients and must be able to conduct effective interviews without knowing the patients or their histories. The advantage of this approach is that the pharmacist is completely unbiased about each patient and the patient's history, which allows the exploration of all aspects of the medication history with equal intensity. The disadvantage of this approach is that it can be an intimidating and time-consuming process for the inexperienced interviewer.

OBSERVATION OF THE PATIENT AND THE PATIENT'S ENVIRONMENT

Close observation of the patient and the patient's immediate surroundings provides important information regarding the patient's state of health, economic status, adherence to specific dietary recommendations, and

social support system.[10] These data help the pharmacist select and monitor the outcomes of specific medication regimens. For example, drugs used to manage hypertension may appear ineffective if the patient refused to comply with salt or other dietary restrictions. Patients may choose to pay the rent or buy groceries rather than buy expensive medications. Patients may not understand complex medication regimens or may not be able to prepare and administer nonoral dosage formulations (e.g., subcutaneous medications, inhaled medications, suppositories).

A patient's general well-being and socioeconomic class can be judged by how the patient is dressed. An unkempt appearance or sloppy dress may indicate that the patient is too ill to pay attention to these details. Other clues to the patient's lifestyle and sense of well-being include makeup, hairstyle, location and number of body piercings, hearing aids, and watches with large numbers or Braille faces. The amount, quality, and type of jewelry provide some information about a patient's socioeconomic status.

Carefully observe the patient for the type, amount, pattern of wear, degree of tidiness, and general fit of clothing (Figure 3-1). Worn, dated clothing suggests that the patient may have difficulty paying for prescribed therapies. Patterns of wear on shoes and shirtsleeves may suggest physical impairment from stroke or other trauma. Long sleeves and broad-brimmed hats inappropriate to the season suggest photosensitivity or an attempt to hide track marks or scars from suicide attempts, trauma, or surgery. Shoes with toes and other areas cut out suggest a history of gout or other joint disease. Oversized clothing may indicate recent weight loss; too-tight clothing may indicate recent weight gain. Note whether belts are buckled at usual wear spots or whether the patient has let the belt out or tightened it up. Loose-fitting house slippers or untied sneakers may indicate recent lower extremity edema. A predominance of snaps, zippers, and Velcro-type fastenings may indicate loss of manual dexterity. A patient with hypothyroidism may dress too warmly; a patient with hyperthyroidism may dress too coolly. Do not, however, read too much into these observations; evaluate these observations in the context of the rest of the data obtained during the patient interview.

Carefully observe an institutionalized patient's room (Figure 3-2). Flowers, plants, get-well cards, and children's drawings indicate that the patient has family and friends who are aware of the patient's illness and are providing social support. Books, newspapers, and magazines indicate that the patient is literate and provide clues about the patient's outside interests. Reading material, crossword puzzles, and crafts such as knitting also indicate that the patient feels well enough to engage in these activities.

The presence of food in a patient's room has several potential meanings. Food gift baskets indicate social support but may indicate potential problems for patients on restricted diets. Food left from prior meals may indicate that the patient is not hungry, has missed a meal while at a test or procedure, or dislikes the institutional food. Many drugs suppress the appetite and contribute to anorexia. Food from home may indicate that the patient dislikes the institutional food or that family and friends are trying to supply special foods and treats to entice a patient to eat. Look for extra or forbidden food in the rooms of patients with diabetes, heavily salted snack foods in the rooms of patients on salt-restricted diets, and soft drinks or water in the rooms of patients who are on fluid restriction. Dietary

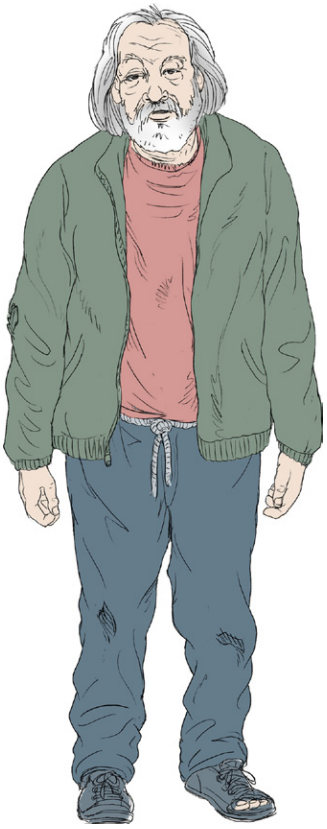

Figure 3-1 Observe the Patient's Clothing. Carefully observe how the patient is dressed. Worn clothing may indicate financial difficulties. A dirty, unkempt appearance may indicate that the patient is too ill to care for himself or herself. Uncharacteristically loose clothing may indicate recent weight loss. Cutout toes in shoes may indicate gout.

Figure 3-2 Observe an Institutionalized Patient's Room. Flowers, plants, get-well cards, children's drawings, and gift baskets indicate social support. The presence of other food items may indicate that the patient is not hungry, has missed a meal, or dislikes the institutional food.

indiscretions may be primary or contributing factors in failure of prescribed therapeutic regimens.

DATA TO BE OBTAINED

Data obtained during the medication history interview include demographic information, dietary information, social habits, current and past prescription medications, current and past nonprescription medications, current and past complementary and alternative medicines, drug allergies, adverse drug reactions, immunizations, and adherence to prescribed or recommended medication regimens (Box 3-6). The data obtained should be as complete and descriptive as possible.

MEDICATION NAMES

Patients may not be able to remember the names of all their medications. If this is the case, obtain a detailed description of each medication, including the dosage form (e.g., tablet, capsule, liquid, topical formulation); size, shape, and color of the dosage form; and any words, letters, and numbers on the dosage form that the patient can remember or that can be seen on the dosage form. If the patient cannot remember the dosage of the drug, the pharmacist may be able to identify the drug and/or dosage from other details the patient provides. However, clearly document the patient's description and note that the medication might be a specific product.

Example: The patient cannot remember the name of the medication but describes it as a purple capsule with yellow rings around the capsule. This description is consistent with Nexium (esomeprazole) 40 mg.

The medication history is an important document for communication among pharmacists and between pharmacists and other health care professionals. Many physicians, nurses, and other health care professionals typically know the proprietary (trade) name of the medication but are less familiar with the nonproprietary (generic) medication names. Therefore when a patient identifies a medication by the proprietary name, document both the proprietary and nonproprietary names. If the patient identifies a medication by the nonproprietary name, document the nonproprietary name. For combination medications, document the nonproprietary names of all active ingredients in the combination product.

Example: Lanoxin (digoxin) 0.25 mg orally once daily.

Example: Ibuprofen 200 mg orally every 4 to 6 hours prn headache.

Example: Tylenol with Codeine No. 3 (acetaminophen 300 mg, codeine 30 mg) 1-2 tablets every 4 hours prn pain.

ON DEMAND (PRN) MEDICATIONS

For as needed (prn, on demand) prescription and nonprescription medications, document the possible use as well as the patient's actual use of the medication. Quantification is important; do not accept imprecise descriptive terms. For example, the term *occasional* may mean anything from one dose of the medication every few months to one or more doses per day depending on the patient. Patients may or may not be able to describe their frequency of use but may be able to describe how often they get the prescription refilled or buy a new supply of nonprescription medication; both give an indirect indication of frequency of use. One approach to quantifying the amount of medication actually consumed by the patient is to inquire how often the patient has to obtain a new supply of the medication.

Example: Acetaminophen 325-650 mg every 4 to 6 hours as needed for headache for 50 years. The patient takes one to two doses per month; very effective. Last taken 2 weeks ago. The patient buys a small bottle of acetaminophen about once a year.

DEMOGRAPHIC INFORMATION

Demographic information includes the patient's age, height, weight, race or ethnic origin, education, occupation, and lifestyle. Lifestyle information includes the patient's housing situation (e.g., boarding house, private home, apartment, shelter, living on the street), the people living with the patient (e.g., spouse, young children, elderly relatives, extended family), and the patient's type of work and work schedule, if applicable (i.e., day shift, night shift, rotating shift schedule, part time, full time). All of these factors influence decisions regarding the selection of prescription and nonprescription medication, the dosage of the medication, and the therapeutic regimen. For example, patients who work with machinery may choose not to take medications that make them drowsy, sluggish, or shaky. Patients with restricted work breaks may be reluctant to take diuretic medications. Patients who live in shelters may not have access to refrigeration. Patients hesitant to give themselves injections may be unwilling to take these types of medications unless someone is available to help them.

Example: The patient is a 61-year-old WM (DOB 7/15/48). Height 5′10″. Weight 216 kg. He lives with his wife in a rented one-story house. He is an unemployed truck driver.

DIETARY INFORMATION

Dietary information includes specific dietary restrictions and any supplements, stimulants, or depressants used. For example, patients with diabetes may follow a reduced-carbohydrate diet; other patients may be consuming recommended or self-imposed low-fat, low-sodium, low-calorie, low-fiber, or high-fiber diets. Dietary information is an important component of the medication history, because some drug therapies may appear ineffective if the patient is nonadherent to recommended dietary restrictions (e.g., patients with congestive heart failure may not comply with salt-restricted diets). Patients may self-medicate with nonprescription dietary supplements, stimulants, or suppressants that interact adversely with prescribed medications and treatment regimens.

Example: The patient follows a salt-restricted diet (<2.4 grams per day) and has for 5 years; no dietary supplements, stimulants, or depressants.

SOCIAL HABITS

Social habits include the use of tobacco, alcohol, and illicit drugs. Document the duration of use, amount of each agent consumed, frequency of use, and reasons for

Box 3-6 Data to be Obtained from a Medication History Interview

DEMOGRAPHIC INFORMATION
Age/date of birth
Height and weight
Race and/or ethnic origin
Type of residence
Education
Occupation

DIETARY INFORMATION
Dietary restrictions
Dietary supplements
Dietary stimulants
Dietary suppressants

SOCIAL HABITS
Tobacco use
Alcohol use
Illicit drug use

CURRENT PRESCRIPTION MEDICATIONS
Name (proprietary and nonproprietary) and/or description
Dose
Dose schedule (prescribed and actual)
Reason for taking the medication
Start date
Outcome of therapy

PAST PRESCRIPTION MEDICATIONS
Name (proprietary and nonproprietary) and/or description
Dose
Dose schedule (prescribed and actual)
Reason for taking the medication
Start date
Stop date
Reason for stopping
Outcome of therapy

CURRENT NONPRESCRIPTION MEDICATIONS
Name (proprietary and nonproprietary) and/or description
Dose
Dose schedule (recommended and actual)
Reason for taking
Start date
Outcome of therapy

PAST NONPRESCRIPTION MEDICATIONS
Name (proprietary and nonproprietary) and/or description
Dose
Dose schedule (recommended and actual)
Reason for taking
Start date
Stop date
Reason for stopping
Outcome of therapy

CURRENT COMPLEMENTARY AND ALTERNATIVE MEDICINES
Name (proprietary and nonproprietary) and/or description
Dose
Dose schedule
Reason for taking
Start date
Outcome of therapy

PAST COMPLEMENTARY AND ALTERNATIVE MEDICINES
Name (proprietary and nonproprietary) and/or description
Dose
Dose schedule
Reason for taking
Start date
Stop date
Reason for stopping
Outcome of therapy

ALLERGIES
Drug name and description
Dose
Date of reaction
Description of reaction
Treatment for the reaction

ADVERSE DRUG REACTIONS
Drug name and description
Dose
Date of reaction
Description of reaction
Treatment of the reaction

IMMUNIZATIONS
Vaccines
Date each vaccine was administered

OVERALL PATIENT ADHERENCE

use of each agent without being judgmental. Determine the type, quantity, pattern, and duration of alcohol use. Alcohol use can be categorized as shown in Table 3-1.[11,12] To assess tobacco use, note at what age the patient first started smoking tobacco and when the patient quit smoking (if applicable). Because the effects of smoking on drug metabolism may be clinically important for weeks to months after the patient has stopped smoking, note approximately when the patient stopped smoking. Pharmacists in acute care settings should be especially sensitive to these issues. Patients often quit smoking just before hospitalization and may consider themselves nonsmokers when asked about their smoking habits.

Tobacco smoking is quantified in terms of packs per day (ppd) and expressed in pack-years (pk-yr) (e.g., 2 ppd for 5 years; 10 pk-yr). One pack-year is equivalent to smoking one pack of cigarettes daily for 1 year (Figure 3-3). A 10 pk-yr tobacco history is equivalent to smoking

Table 3-1 Alcohol Use Categories (Adults)

Category	Men	Women
Lifetime abstainer	<12 drinks in lifetime	<12 drinks in lifetime
Former infrequent drinker	≥12 drinks in lifetime but <12 drinks in any single year and no drinks in the past year	≥12 drinks in lifetime but <12 drinks in any single year and no drinks in the past year
Current drinker	≥12 drinks in lifetime and ≥1 drink in the past year	≥12 drinks in lifetime and ≥1 drink in the past year
Infrequent drinker	1-11 drinks in past year	1-11 drinks in past year
Light drinker	≤3 drinks per week	≤3 drinks per week
Moderate drinker	>3 and up to 14 drinks per week	>3 and up to 7 drinks per week
Heavier drinker	>14 drinks per week (>2 drinks per day on average)	>7 drinks per week (>1 drink per day on average)
Binge drinker	≥5 drinks in about 2 hours	≥4 drinks in about 2 hours

Adapted from Schoenborn CA, Adams PF, Barnes PM, et al: Health behaviors of adults: United States, 1999-2001. National Center for Health Statistics. *Vital Health Stat* 10(219):1-79, 2004; National Institute of Alcohol Abuse and Alcoholism: NIAA council approves definition of binge drinking. *NIAAA Newsletter* (3):3, 2004. Available at: http://pubs.niaa.nih.gov/publications/Newsletter/winter2004/Newsletter_Number3.pdf. Accessed November 6, 2009.

0.5 ppd for 20 years, 1 ppd for 10 years, or 2 ppd for 5 years.

Illicit drug use may be difficult to ascertain. Obtain this information in a professional, nonthreatening, nonjudgmental manner. Do not try to guess which patients are more or less likely to use these agents but probe for this information with every patient. Surprisingly, patients may be more comfortable revealing this type of information to pharmacists than to other health care professionals, including physicians. Patients generally do not understand the term *illicit*. The best approach is to ask about the use of so-called street drugs and give an example or two, such as marijuana, crack cocaine, and heroin. Document the amount of each agent consumed; the frequency, pattern, and duration of use; and the reasons for use of each agent.

Example: The patient has smoked 1 ppd for 10 years (10 pk-yr). The patient does not currently drink alcohol but previously was a heavier drinker, drinking one six-pack of beer per day for 10 years; his last drink was 1 year ago. The patient used marijuana two or three times 10 years ago.

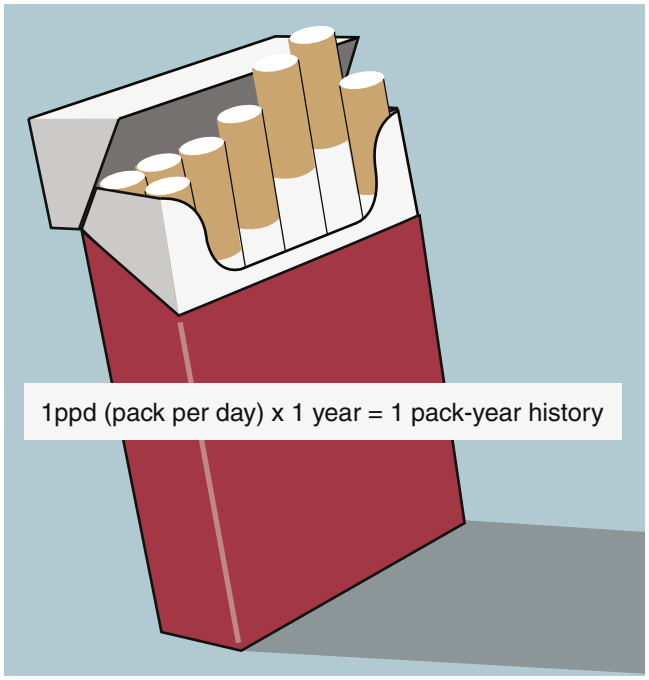

Figure 3-3 Tobacco Smoking Quantification. A 1 pack-year tobacco smoking history is equivalent to smoking one pack of cigarettes daily for 1 year.

CURRENT PRESCRIPTION MEDICATIONS

Obtain a complete list of the patient's current prescription medications, including the name and dosage of the drug, dosing schedule (prescribed and actual), duration of therapy (start date), reason the patient is taking the medication, and outcome of therapy. Knowledge of current prescription medications allows the pharmacist to evaluate the efficacy and safety of prescribed regimens.

Obtain the prescribed dosing schedule (e.g., four times a day, two times a day, once a day) and note the routine times the patient takes each dose. If a discrepancy between the prescribed dosing schedule and the schedule the patient uses is apparent (e.g., the patient is supposed to take the medication four times a day but takes it two times a day), note the discrepancy and try to determine the reason the patient uses the drug differently from the way it is prescribed. Patients sometimes change dosing schedules to fit their work schedules and lifestyles or to conserve medication to reduce the expenses of long-term medications.

Determine when the patient started taking the prescription medication and the reason the patient gives for taking the medication. Exact dates are important in determining whether an adverse or allergic reaction is a result of a specific medication and whether the prescribed medication is effectively treating or controlling a specific condition. For example, a patient with elevated blood pressure may claim to adhere to his or her blood pressure medication regimen yet still have elevated blood pressure. The decision to continue or discontinue the medication depends on when the patient started the current regimen. The regimen would continue unchanged if the patient had just started the medication the previous week but would need to be changed

if the patient had been taking the medication for 2 months. Some patients may not know the specific reason they are taking their medications because they forgot or misunderstand the reason it has been prescribed. Document the reasons the patient gives for taking the medication and clarify any discrepancies regarding customary uses of medications with the prescriber, not the patient.

Example: Hydrochlorothiazide (Esidrex) 50 mg daily for 5 years for high blood pressure. The patient reports that her blood pressure has been well controlled with this regimen.

Example: The patient takes a small oblong pink tablet twice daily for treatment of high blood pressure. The patient cannot remember the name of the medication or when she started taking it. The patient doesn't think it works very well because her blood pressure is always high.

PAST PRESCRIPTION MEDICATIONS

Obtain as much information about past prescription medications as possible, including name and description, dosage, prescribed and actual dosing schedule, dates and duration of therapy, reason for taking the medication, and outcome. Knowledge of past prescriptions helps the pharmacist understand the medications used, either successfully or unsuccessfully, to treat current and past medical problems; this knowledge guides recommendations regarding new medication regimens. Patients are unlikely to remember all these details for past medications. Document the details the patient can remember; avoid excessive "grilling" of the patient.

Document any other information the patient provides about the past medications as well as the reason the patient stopped taking the medications. Medication regimens may be short and well defined, as with antibiotic therapy, or multiple medications may be tried over a prolonged period in an effort to find an effective medication with an acceptable side effect profile.

Example: The patient was diagnosed with hypertension 5 years ago. He initially took hydrochlorothiazide 25 mg daily for 2 years then was switched to Vasotec (enalapril) 5 mg daily for 3 years before being switched to his current medication. The medications were changed because his blood pressure was still too high.

CURRENT NONPRESCRIPTION MEDICATIONS

Obtain a complete description of current nonprescription medications from the patient. Document the name and dosage of the drug, recommended and actual dosing schedule, dates and duration of therapy, reason the patient is taking the medication, and outcome of therapy. Knowledge of current nonprescription medications allows the pharmacist to determine whether drug interactions may occur between prescribed and self-administered medications, whether the patient is self-medicating to relieve an adverse drug reaction from a prescribed medication or in an attempt to obtain better relief from symptoms than that provided by the prescribed regimen, and whether a nonprescription medication is the cause of a patient's complaint or is exacerbating a concurrent medical condition.

Example: The patient is currently using bacitracin ointment on a cut on his finger. He washes the cut with soap and water and applies a thin layer of bacitracin to the cut twice a day. He started using the bacitracin ointment 2 days ago when he accidentally cut himself. The wound is healing well.

PAST NONPRESCRIPTION MEDICATIONS

Obtain as much information as possible about past nonprescription medications, including name and description, dosage, prescribed or recommended and actual dosing schedule, dates and duration of therapy, reason for taking, reason for stopping, and outcome. Knowledge of past nonprescription regimens gives the pharmacist insight regarding past medical problems or attempts to treat current medical problems. As with prescription medications, patients are unlikely to remember all of these details for past medications. Document the details the patient can remember; avoid excessive "grilling" of the patient.

Example: The patient takes Benadryl (diphenhydramine) 50 mg one capsule at bedtime as needed for insomnia. He started using Benadryl 5 years ago and on average takes four or five doses two or three times a year. He last took Benadryl 2 months ago and says it works well.

CURRENT AND PAST COMPLEMENTARY AND ALTERNATIVE MEDICINES

Approximately 7% of Americans take complementary and alternative medicines (e.g., herbal remedies, megavitamins, homeopathic medicine, folk remedies).[13] However, the majority of people do not discuss these therapies with their physicians.[13] Many of these medicines interact with traditional medicines. Some have significant side effects. Therefore, it is important to document the use of these medicines.

Obtain a complete description of current and past alternative medicine use. Document the name and dosage of the product, dosing schedule, duration of therapy, reason the patient is taking the product, start and stop dates or approximate duration and timing of use, and outcome of therapy. Ask the patient follow-up questions to clarify why the patient is taking the alternative medicine. For example, if a patient states that he or she is taking an alternative medicine to boost the immune system, ask the patient whether anyone has ever told the patient that he or she has a weakened immune system and whether the patient gets more infections than most people. As with many prescription and nonprescription medications, many alternative remedies are taken prn. Quantification of the exact amount of product consumed by the patient may be difficult. However, quantification is important; do not accept imprecise descriptive terms. As with prescription and nonprescription drugs, ask the patient how often he or she buys a new supply of the product to make an indirect assessment of the amount of product taken by the patient.

Example: The patient takes milk thistle 200 mg three times daily "for my liver." She started taking it 6 months ago and believes it is working to keep her liver healthy.

*Example: The patient took Cold-fx (*Panax quinquefolius*) 3 capsules tid day 1, 2 capsules tid day 2, 1 capsule tid day 3 when she had a cold last month. She said it shortened the duration of her cold.*

IMMUNIZATIONS

Vaccinations are important for the health of individuals and the public. The Centers for Disease Control and Prevention (CDC) immunization recommendations are complex and difficult for an individual patient to understand. Traditionally, patients have relied on their primary care providers to maintain their immunization records, but now that all 50 states allow certified licensed pharmacists to vaccinate patients,[14] pharmacists can provide this service. This increases the importance of the pharmacist's obtaining and maintaining an accurate immunization record as part of the medication history. Record the name of the vaccine and the date the vaccine was given. Patients may not know the specific details; record the information the patient can supply. Patients, especially those with chronic diseases, may have lifetime vaccination administration records. If so, the record may contain specific details the patient cannot remember (i.e., date given, site, lot number, manufacturer, and signature of vaccinator).

Example: Tdap (tetanus, diphtheria) 2005; pneumococcal polysaccharide 2009; zoster 2007; influenza 2009.

MEDICATION ALLERGIES

Many physicians, nurses, and other health care professionals as well as patients may be unable to differentiate between a drug allergy and an adverse drug reaction. But it is very important to try to distinguish between the two reactions. Once a medication allergy is documented for a patient, it is highly unlikely that the patient will receive the medication or a similar medication again. If the reaction was a manageable or acceptable adverse reaction rather than an allergic reaction, however, the patient may be unnecessarily denied access to potentially useful medications. The term *allergy* indicates hypersensitivity to specific substances. Drug-induced allergic reactions include anaphylaxis, contact dermatitis, and serum sickness.

A useful first step is to ask patients whether they are allergic to any medications and then probe for the details of the problem, depending on the response. Ask patients if they have ever experienced rashes or breathing problems after taking any medications. Patients may not correlate a rash with an allergy, so it is important to probe for these details.

After a medication has been identified as the cause of an allergic reaction, ask the patient to provide details regarding the time or date of the allergic reaction and any interventions instituted to manage the reaction, and inquire whether the patient has received the medication since first experiencing the allergic reaction. Ask whether medications in similar drug classes have been taken without the occurrence of a similar reaction (i.e., "Have you taken any antibiotics since you found out you were allergic to penicillin?").

Advise patients who have had documented life-threatening allergic reactions about programs such as the MedicAlert program, which provide patients with necklaces and bracelets engraved with patient-specific allergy information.

Example: The patient is allergic to penicillin. The patient had an itchy rash over his whole body after taking a couple of doses of penicillin 20 years ago. His doctor told him to stop taking the medication and that he was allergic to the drug. He remembers taking some kind of oral medication that stopped the itching but doesn't remember the name of that medication. He has not taken penicillin since that episode.

ADVERSE DRUG REACTIONS

Adverse drug reactions are unwanted pharmacologic effects associated with medications. Examples of adverse drug reactions include drowsiness from first-generation antihistamines, constipation from codeine-containing medications, nausea from theophylline, and diarrhea from ampicillin. The patient may identify some adverse drug reactions during the discussion of medication allergies. Ask patients whether they have ever taken a medication they would rather not take again. This question often elicits specific descriptions of adverse reactions the patient has experienced. Determine the name of the medication, the dosage, the reason the patient was taking the medication, the date of the reaction, the details of the adverse reaction, and the way the patient dealt with the reaction (e.g., discontinued the medication, decreased the dosage of the medication, took another medication to treat the adverse reaction).

Example: The patient felt dizzy and had strange dreams after taking one dose of Darvon (propoxyphene) 10 years ago for pain after some dental work. He threw out the rest of the prescription and has not taken Darvon since then.

ADHERENCE

One of the goals of the medication history interview is to determine whether the patient is adherent to prescribed or recommended medication regimens. Knowledge regarding patient adherence is useful in evaluating the effectiveness of prescribed or recommended medication regimens. Medications may be ineffective if the patient does not comply with the prescribed or recommended regimen. Nonadherence may result in additional diagnostic evaluations, procedures, hospitalizations, and unnecessary combination medication regimens.

Adherence is difficult to determine through direct questioning. Patients know they are supposed to take their prescribed and/or recommended medications. When confronted by an authority figure, patients most likely will say they are adherent even if they are not. Therefore evaluate the patient's adherence by gentle probing throughout the interview. Clues about adherence may be obtained through patient descriptions of how they take their prescribed medications. Many patients can describe their medication routines in detail (e.g., setting out a day's worth of doses in the morning, lining up the bottles in a special location, crossing off dates on a calendar); other patients may not be able to describe any sort of routine or

even recall the color or shape of the medication. Patients who can convincingly describe their medication routines are more likely to be adherent than patients who can provide only vague and general descriptions of their medications and routines.

Sympathetic confrontation may help the pharmacist obtain information regarding patient adherence. Patients are more likely to be truthful when describing their difficulties with complying with the medication regimen if the pharmacist acknowledges that the dosage regimen is complex and difficult to follow and that taking medication regularly is hard. Remain nonjudgmental when assessing patient adherence; this attitude encourages the patient to trust the pharmacist and tell the truth about adherence to prescribed medication regimens.

Example: The patient is nonadherent. She admits that she picks and chooses which medication to take and that she takes the medications the way she wants to, not as prescribed.

Example: The patient is adherent. He knows the names and descriptions of all of his medications and is able to describe his usual routine for taking the medications. He says his wife helps him remember to take the medications.

THE DIFFICULT INTERVIEW

Some patients are especially difficult to interview. Recalcitrant patients, verbose patients, confused patients, patients whose command of the English language is limited, patients with hearing impairments, patients with aphasia, impatient patients, and patients hospitalized in isolation rooms all may be difficult to interview. Although these types of patients may intimidate even the most experienced interviewer, it is important to obtain accurate medication histories from them.

Many interventions are possible. The best approach for recalcitrant or verbose patients is to exert firm control of the interview and ask directed questions to draw information from the recalcitrant patient and redirect the verbose patient. The confused or aphasic patient may be unable to provide any specific information. In this situation, interview family members and friends of the patient. Interpreters are available for many foreign languages in most institutions; take advantage of these resources. Enhance communication with patients with hearing impairments by ensuring that the patient's hearing aid (if any) is turned on, by speaking clearly and distinctly, and by sharing written information with the patient. Remind the impatient patient of the usefulness of an accurate medication history and try to obtain the history efficiently and in a reasonable amount of time.

The process for interviewing patients in isolation rooms (e.g., respiratory isolation, enteric isolation, infectious disease isolation) is the same as the process for interviewing any other hospitalized patient with the exception that precautions (e.g., use of masks, gowns, gloves) must be taken. These requirements usually are posted and available outside the patient's room. Be aware that these precautions may present barriers to communication. Most patients in isolation are especially eager to be interviewed, because isolation prevents much of the casual human contact that routinely takes place with institutionalized patients.

DOCUMENTATION OF THE MEDICATION HISTORY

The details of the medication history are documented in writing and communicated to the health care team. Many standardized patient profile forms have specific areas for the documentation of this information. Some institutions use standardized medication history forms that are filled out, signed, and placed in the patient medical record (Figure 3-4). These standardized forms are relatively easy to complete and are easy to scan for specific information. However, standardized forms are inflexible and may not contain adequate space for documentation of patient-specific information. Document the medication history in the patient record using either the SOAP format (*S*ubjective, *O*bjective, *A*ssessment, *P*lan) (Figure 3-5) or a freestyle format (Figure 3-6) if standardized forms are not available. The SOAP format organizes the medication history information into four sections: subjective data, objective data, assessment, and plan. The information is well organized, but it is hard for readers to scan the document for specific information. The freestyle format organizes the information into whatever structure the pharmacist thinks best for the information. It is easy to write a medication history in a freestyle format, but finding specific details may be difficult. Important information is more likely to be left out in this format than with other formats.

Regardless of the format used to document the information, it is important to document every component of the medication history. Documenting that the patient is not currently taking any prescription drugs is as important as documenting that the patient is currently taking a long list of prescription drugs. Document all the details. Write clearly. Document both the nonproprietary drug name (the name intended for unrestricted public use; sometimes referred to as the *generic drug name*) and the proprietary drug name (the legally trademarked name) when the patient refers to a medication by the proprietary name. Document just the nonproprietary drug name if the patient refers to the drug by the nonproprietary name. For example, if the patient says she takes Avandia, document the proprietary name Avandia and the nonproprietary name rosiglitazone. If the patient says he takes pseudoephedrine, document the nonproprietary name pseudoephedrine. Checklists may be useful (Box 3-7).

APPLICATION ACTIVITY

This activity is best performed with a small group (five to eight group members), although it can be done with a larger group observing the interview. Select one person to be the patient. Instruct the patient to answer the medication history questions according to the script that follows but not to volunteer any information without being directly asked (e.g., play the role of a reluctant patient). Give the group members a few minutes to strategize among themselves, then give the group about 20 minutes to interview the patient for the medication history. After the interview is complete, have the group document the medication history using any of the three formats described earlier. Then

Medication History		
Patient: Brian Flannery		**Date:** 8/31/10
DOB: 11-2-60	**Height:** 5'10"	**Weight:** 80 kg
Current Prescription Medications (nonproprietary/proprietary names, start date, dose, schedule, indication): Cozaar (losartan) 50 mg daily; started in 2005 for hypertension; BP well controlled Hydrochlorothiazide 25 mg daily; started in 2005 for hypertension; BP well controlled		
Past Prescription Medications (nonproprietary/proprietary names, start date, dose, schedule, indication): Per the patient's chart: Hydrochlorothiazide 25 mg daily; started in 2002; stopped in 2004; for hypertension Vasotec (enalapril) 5 mg daily; started in 2004; stopped in 2005; for hypertension		
Current Nonprescription Medications (nonproprietary/proprietary names, start date, dose, schedule, indication): No current nonprescription medication.		
Past Nonprescription Medications (nonproprietary/proprietary names, start date, dose, schedule, indication): Tylenol (acetaminophen) 325-650 mg every 4-6 hours PRN headache/pain × 40 years. Takes 3-4 doses per month. Very effective.		
Current Complementary and Alternative Medicines (nonproprietary/proprietary names, start date, dose, schedule, indication): Garlique 400 mg daily to lower his cholesterol; started in 2008; thinks it is working		
Past Complementary and Alternative Medicines (nonproprietary/proprietary names, start date, stop date, dose, schedule, indication): No past complementary and alternative medicines.		
Immunizations (vaccine, date given) Influenza 2009; tetanus/diphtheria 2003		
Allergies (proprietary/nonproprietary names, dates, description of event, treatment): Penicillin causes an itchy rash; happened when he was 25 years old. The rash went away when he stopped taking the drug.		
Adverse Drug Reactions: Codeine caused nausea and vomiting when he took it after having his wisdom teeth removed when he was 20 years old.		
Social History: WM; lawyer; lives in own home with wife + Tobacco (1ppd × 32 years; 32 40 pk-yrs) + Alcohol (1-2 glasses of wine with dinner 3-4 nights per week × 20 years); moderate drinker Denies use of illicit drugs.		
Dietary Information (restrictions, supplements, stimulants): Restrictions: Low-fat diet (< 20 grams of fat per day) for ve years. Supplements: None Stimulants: None Suppressants: None		
Assessment of Patient Compliance: Noncompliant; skips his blood pressure medications several times a month.		
Pharmacist: Jane Doe, Pharm.D., RPh		

Figure 3-4 Medication History—Standardized Form. Standardized forms are easy to fill out but are inflexible.

check the completeness of the medication history using the checklist and check the accuracy of the medication history using the patient script.

Luke Miller (LM) is a Hispanic male (date of birth, December 4, 1954) who works as a financial advisor and lives in a house in the suburbs. He is 5′7″ tall and weighs 183 kg.

LM has drunk one to two beers per week for the last 30 years and has smoked two to three packs of cigarettes per day for the past 25 years. He snorted crack cocaine in college two or three times per week for 3 years but has not used an illicit substance since.

LM is currently trying to quit smoking and has been taking the prescription medication varenicline (Chantix) 1 mg twice daily for the past 12 weeks. Before starting varenicline, he took bupropion (Zyban) 150 mg twice daily for 7 weeks but was unable to to quit smoking.

LM says he is allergic to amoxicillin because his mother told him he developed a rash while taking it as a baby. He had an adverse reaction to diphenhydramine (Benadryl) (very dry mouth and eyes) when he used it once or twice in his thirties to help him sleep. He hasn't taken diphenhydramine since.

LM is currently taking Nicorette (nicotine polacrilex gum) 2 mg mint for breakthrough nicotine cravings. He currently chews two or three pieces of gum per day and has been using it for the past 12 weeks.

LM takes the complementary and alternative medicine red yeast rice 600 mg capsules two capsules twice daily with breakfast and dinner to help control his cholesterol. He started taking the red yeast rice 7 years ago.

LM has no dietary restrictions and takes no dietary supplements or suppressants. His only dietary stimulant is three to four cups of coffee per day for the past 5 years.

LM is very adherent to his medication regimen because he is determined to quit smoking. He understands how and when to take the Chantix and when to use the Nicorette gum.

8/31/10 Medication History

S: Brian Flannery is a 50 year old 5'10" WM (DOB 11-2-60) with a history of HTN since 2002. He has been taking Cozaar (losartan) 50 mg daily and hydrochlorothiazide 25 mg daily to treat his HTN since 2005 and says his blood pressure is well controlled. He used to take other medications for his HTN but doesn't remember their names, dosages, or dates he took the medications. BF is not currently taking any nonprescription medications but takes Tylenol (acetaminophen) 325-650 mg every 4-6 hours PRN headache/pain 40 years. He takes 3-4 doses per month and says it is relieves the HA/pain very well. BF takes Garlique 400 mg daily to lower his cholesterol; started in 2008 and says his cholesterol is good. He says he has never taken any other complementary or alternative medications. His last influenza vaccine was in 2009 and his last tetanus/diphtheria vaccine was in 2003. BF is allergic to penicillin. He says that penicillin caused an itchy rash when he took it for the first time when he was 25 years old. He stopped taking the penicillin and the rash went away without any other treatment. BG doesn't take codeine because it caused nausea and vomiting after he took it when his wisdom teeth were removed when he was 20 years old. BF is a lawyer. He lives in his own home with his wife. He smokes tobacco 1ppd 32 years (32 pk-yrs), drinks 1-2 glasses of wine with dinner 3-4 nights per week 20 years (moderate drinker) and denies ever using illicit drugs. He has been following a low-fat diet (20 grams of fat per day) for five years. He says he doesn't take dietary supplements, stimulants or suppressants. BF admits to skipping his blood pressure medications several times a month.

O: Per the patient's medical record, BF's past prescription antihypertensive medications include hydrochlorothiazide 25 mg daily (started in 2002 and stopped in 2004) and Vasotec (enalapril) 5 mg daily (started in 2004 and stopped in 2005). The lastseveral charted blood pressures were in the 140's/90's range.

A: BF has a good recall of his current medications but skips doses of his antihypertensive medications. His blood pressure is not well controlled.

P: Counsel the patient regarding the importance of taking his antihypertensive medications as prescribed. Advise the patient to monitor his blood pressure twice a day at home and to contact his physician if the blood pressures remain elevated.

Jane Doe, Pharm.D., RPh

Figure 3-5 Medication History—SOAP Format. The SOAP (*S*ubjective, *O*bjective, *A*ssessment, *P*lan) format produces well-organized information, but it may be difficult for others to locate specific information.

SELF-ASSESSMENT QUESTIONS

1. Which of the following is a disadvantage of reviewing all available information about a patient before interviewing the patient?
   a. The pharmacist feels more comfortable.
   b. The pharmacist is prepared to address specific issues.
   c. The pharmacist may be too focused and overlook important issues.
   d. The pharmacist is completely unbiased about all aspects of the history.
   e. The pharmacist feels more intimidated.
2. Which organization requires hospitals to have a medication reconciliation process?
   a. The Joint Commission
   b. The National Institutes of Health
   c. The Centers for Disease Control
   d. The American Medical Association
   e. The National Cancer Institute
3. During a patient interview the pharmacist observes that the patient's clothing has a predominance of Velcro-type fastenings. This may indicate which of the following?
   a. Photosensitivity
   b. Recent weight loss
   c. Recent weight gain
   d. Loss of manual dexterity
   e. Hypertension
4. Demographic patient information includes all of the following *except:*
   a. Age
   b. Height
   c. Weight
   d. Ethnic origin
   e. Dietary restrictions
5. A patient states that he has smoked two packs of cigarettes a day for 30 years. What is the patient's pack-year smoking history?
   a. 2 pk-yr
   b. 15 pk-yr
   c. 30 pk-yr
   d. 60 pk-yr
   e. 90 pk-yr
6. What is the alcohol use category for a person who drinks three drinks on average per day?
   a. Infrequent drinker
   b. Light drinker
   c. Moderate drinker
   d. Heavier drinker
   e. Binge drinker
7. Current prescription information includes all of the following *except:*
   a. The name and description of the drug
   b. The date or time the medication was stopped
   c. The dosage of the drug
   d. The prescribed and actual dosing schedule
   e. The date or time the medication was started

8/31/10 **Medication History**

Brian Flannery is a 50 y/o 5'10" WM (DOB 11-2-60) with a history of HTN diagnosed in 2002.

Social History: Lawyer; lives in his own house with his wife. He smokes tobacco 1ppd 32 years (32 pk-yrs), drinks 1-2 glasses of wine with dinner 3-4 nights per week 20 years (moderate drinker) and denies ever using illicit drugs.

Dietary: Low-fat diet (20 grams of fat per day) 5 years; no dietary supplements, stimulants or suppressants.

Allergies: Penicillin; caused an itchy rash when he took penicillin for the first time when he was 25 years old. The rash went away when he stopped taking it.

Adverse Drug Reactions: Codeine; caused nausea and vomiting when it took it after his wisdom teeth were removed when he was 20 years old.

Current Prescription Medications:
cozaar (losartan 50 mg daily; started in 2005 for HTN; says BP well controlled
Hydrochlorothiazide 25 mg daily; started in 2005 for HTN; says BP well controlled

Past Prescription Medications:
Per the patient's chart:
Hydrochlorothiazide 25 mg daily for HTN (2002-2004)
Vasotec (enalapril) 5 mg daily for HTN (2004-2005)

Current Nonprescription Medications:
None

Past Nonprescription Medications
Tylenol (acetaminophen) 325-650 mg every 4-6 hours PRTN HA/pain 40 years; takes 3-4 doses per month. Effective.

Current Complementary and Alternative Medicines:
Garlique 400 mg daily to lower his cholesterol; started in 2008; thinks it is working

Past Complementary and Alternative Medicines:
None.

Immunizations:
Influenza 2009; tetanus/diphtheria 2003

Compliance:
BF says he skips his blood pressure medications several times a month.

Jane Doe, Pharm.D.,RPh

Figure 3-6 Medication History—Freestyle Format. The freestyle format is a very flexible format, but information may be difficult to find.

8. What information is documented regarding a suspected medication allergy?
   a. The date or time the reaction occurred
   b. The interventions performed to manage the reaction
   c. Whether the patient has received similar medication since that time
   d. All of the above
   e. None of the above
9. Which of the following questioning techniques is *least* likely to result in an accurate assessment of patient adherence?
   a. Directly questioning the patient
   b. Gently probing
   c. Confronting the patient sympathetically
   d. Being nonjudgmental during questioning
   e. Asking the patient to describe the daily routine
10. In general, which of the following types of questions should be avoided when interviewing patients?
    a. Leading questions
    b. Multiple questions
    c. Excessive yes/no questions
    d. All of the above
    e. None of the above
11. Which of the following is the best approach to obtain a medication history from verbose patients?
    a. Asking directed questions
    b. Interviewing family members
    c. Using an interpreter
    d. Speaking slowly and loudly
    e. Interviewing the patient's friends
12. Which one of the following is a disadvantage of documenting a medication history using the freestyle format?
    a. The format is inflexible.
    b. Scanning the document for specific details is difficult.
    c. Space may not be available for all patient information.
    d. All of the above
    e. None of the above

Box 3-7 Medication History Checklist

Format:
- ☐ The history is written in black ink.
- ☐ The date and time of the interview are noted.
- ☐ The history includes an appropriate heading (e.g., Medication History).
- ☐ The history is signed (and cosigned if written by a student).

Details:
- ☐ All medications are referred to by nonproprietary and (if applicable) proprietary names; a complete description of the dosage form is provided if the name is not known.
- ☐ The start date is noted for all medications and social and recreational drugs.
- ☐ The stop date is noted for all past medications and social and recreational drugs.
- ☐ The dose and interval are noted for all medications.
- ☐ The indication for each medication is noted.
- ☐ The actual use of each prn (as needed) medication is noted ("as needed" and "occasional" are not acceptable descriptions).
- ☐ The actual use of each social and recreational drug is noted ("as needed" and "occasional" are not acceptable descriptions).
- ☐ The details of all adverse reactions are noted (drug, date, reaction, treatment).
- ☐ The details of all medication allergies are noted (drug, date, reaction, treatment).

Components:
- ☐ Patient demographics
- ☐ Current prescription medications
- ☐ Current nonprescription medications
- ☐ Current alternative and complementary medicines
- ☐ Past prescription medications
- ☐ Past nonprescription medications
- ☐ Past alternative and complementary medicines
- ☐ Immunizations
- ☐ Medication allergies
- ☐ Adverse drug reactions
- ☐ Dietary information
- ☐ Assessment of adherence

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Audio glossary terms
Medication history checklist

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Chapter 4 - Physical Assessment Skills

Learning Objectives•Name the four fundamental physical assessment techniques and describe how to perform each of the techniques.•Identify the components of the stethoscope, ophthalmoscope, and otoscope and state how to use each instrument.•Describe how to use a tuning fork and a reflex hammer.•Describe how to assess each of the major organ systems.•Define common physical assessment terms.•Interpret common physical assessment abbreviations.

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Chapter Outline

- The Process
- Inspection, Palpation, Percussion, and Auscultation Techniques
- Equipment
  -
    - Stethoscope
    - Sphygmomanometer
    - Ophthalmoscope
    - Otoscope
    - Reflex Hammer
    - Tuning Fork
    - Other Equipment
- Vital Signs
  -
    - Techniques
      -
        - Arterial Pulse
        - Respiration
        - Blood Pressure
        - Temperature
        - Height and Body Weight
        - Terminology
- Skin
  -
    - Techniques
      -
        - Inspection
        - Palpation
        - Terminology
          -
            - Fingernail and Toenail Terms

        - Lesions, Primary
        - Lesions, Secondary
        - Lesions, Other
- Head and Neck
    -
    - Techniques
        -
            - Inspection
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            - Auscultation
            - Hearing
            - Terminology
- Chest and Lungs
    -
    - Techniques
        -
            - Inspection
            - Percussion
            - Palpation
            - Auscultation
            - Terminology
- Cardiovascular System
    -
    - Techniques
        -
            - Inspection
            - Palpation
            - Auscultation
            - Terminology
- Breasts and Axillae
    -
    - Techniques
        -
            - Inspection
            - Palpation
            - Terminology
- Abdomen
    -
    - Techniques
        -
            - Inspection
            - Auscultation
            - Percussion
            - Palpation
            - Terminology
- Genitourinary System

-
  - Techniques
    -
      - Inspection
      - Palpation
      - Terminology
- Musculoskeletal System
  -
  - Techniques
    -
      - Inspection
      - Palpation
      - Terminology
- Neurologic System
  -
  - Mental Status
  - Sensory and Motor Function
  - Cerebellar Function
  - Reflexes
    -
      - Terminology
  - Application Activities
- References

Information obtained from the physical examination along with data obtained during a patient medication history interview and laboratory data are used to assess patient response to drug and nondrug therapy. Although the need for hands-on proficiency in specific physical assessment skills varies according to the type of patient care setting, all pharmacists need a basic understanding of these skills. At a minimum, all pharmacists must know common physical assessment acronyms (Table 4-1) and understand the meaning of specific physical assessment findings documented by other health care professionals. Pharmacists in some clinical settings (e.g., ambulatory care clinics) routinely assess patient response to medication regimens themselves using a variety of physical assessment skills. Although the practice settings requiring proficiency in a broad range of physical assessment skills are currently relatively few in number, the need for these skills continues to grow as pharmacists assume more direct patient care responsibilities.

Table 4-1. Common Physical Assessment Acronyms

Abbreviation	**Meaning**
ABDOMINAL	
Abd	Abdomen
BRBPR	Bright red blood per rectum
BS	Bowel sounds
CM	Costal margin

Abbreviation	Meaning
HJR	Hepatojugular reflex
HSM	Hepatosplenomegaly
LCM	Left costal margin
LLQ	Left lower quadrant
LUQ	Left upper quadrant
NABS	Normal active bowel sounds
NTND	Nontender, nondistended
RCM	Right costal margin
RLQ	Right lower quadrant
RUQ	Right upper quadrant
CARDIOVASCULAR	
AI	Aortic insufficiency
AR	Aortic regurgitation
AS	Aortic stenosis
5ICS MCL	Fifth intercostal space midclavicular line
CV	Cardiovascular
JVD	Jugular venous distention
JVP	Jugular venous pressure
LLSB	Left lower sternal border
M	Murmur
MAP	Mean arterial pressure
MR	Mitral regurgitation
MRG	Murmurs, rubs, gallops
MS	Mitral stenosis
MVP	Mitral valve prolapse
NSR	Normal sinus rhythm
OS	Opening snap
PMI	Point of maximal impulse
RRR	Regular rate and rhythm
S_1	First heart sound
S_2	Second heart sound
S_3	Third heart sound
S_4	Fourth heart sound
SEM	Systolic ejection murmur

Abbreviation	Meaning
USB	Upper sternal border
EXTREMITIES	
AKA	Above-knee amputation
BKA	Below-knee amputation
CCE	Cyanosis, clubbing, and edema
CVA	Costovertebral angle
CVAT	Costovertebral angle tenderness
DP	Dorsalis pedis
FROM	Full range of motion
LE	Lower extremity
LLE	Left lower extremity
LUE	Left upper extremity
PT	Popliteal
RLE	Right lower extremity
ROM	Range of motion
RUE	Right upper extremity
Tr	Trace
UE	Upper extremity
GENERAL	
ABW	Actual body weight
AF	Asian female
AM	Asian male
A&O×3	Awake (alert) and oriented to person, place, and time
A&P	Auscultation and percussion
A&W	Alive and well
BF	Black female
BM	Black male
BP	Blood pressure
BPM	Beats per minute
Bx	Biopsy
DBP	Diastolic blood pressure
HF	Hispanic female
HM	Hispanic male

Abbreviation	Meaning
HR	Heart rate
IBW	Ideal body weight
LBW	Lean body weight
AAF	African American female
AAM	African American male
NAD	No active disease
PE	Physical examination
ppd	Packs per day
SBP	Systolic blood pressure
T	Temperature
$T_{(a)}$	Temperature, axillary
$T_{(po)}$	Temperature, oral
$T_{(R)}$	Temperature, rectal
$T_{(T)}$	Temperature, topical
VS	Vital signs
VSS	Vital signs stable
WDWN	Well-developed, well-nourished
WF	White female
WM	White male
WNL	Within normal limits
y/o	Years old
HEAD, EYES, EARS, NOSE, AND THROAT	
C/D	Cup to disc ratio
EOMI	Extraocular muscles intact
HEENT	Head, eyes, ears, nose, and throat
IOP	Intraocular pressure
NCAT	Normocephalic, atraumatic
NR	Nonreactive
OD	Right eye
OS	Left eye
PERRLA	Pupils equal, round, and reactive to light and accommodation
SCM	Sternocleidomastoid

Abbreviation	Meaning
SHEENT	Skin, head, eyes, ears, nose, and throat
TM	Tympanic membrane
NEUROLOGIC	
AC	Air conduction
AC > BC	Air conduction greater than bone conduction
Bab	Babinski reflex
BC	Bone conduction
BC > AC	Bone conduction greater than air conduction
CN	Cranial nerve
CN II-XII	Cranial nerves II through XII
DTR	Deep tendon reflexes
FTN	Finger to nose
HTS	Heel to shin
MMSE	Mini-Mental State Examination
MS	Mental status
MSE	Mental status examination
NM	Neuromuscular
PP	Pinprick
RAM	Rapid alternating movements
PULMONARY	
AP	Anteroposterior
BS	Breath sounds
CTA	Clear to auscultation
E→A	Egophony
LLL	Left lower lobe
LUL	Left upper lobe
PA	Posteroanterior
RLL	Right lower lobe
RML	Right middle lobe
RR	Respiratory rate
RUL	Right upper lobe

This chapter introduces the pharmacist to the techniques, assessments, and terminology associated with the physical examination. In addition, specific step-by-step checklists are provided for techniques commonly employed by pharmacists (e.g., vital sign measurement, cardiovascular assessment, pulmonary assessment). The physical examination is a complex

process that requires significant effort and experience to master. Pharmacists interested in learning more about the physical examination should refer to one or more of the excellent in-depth physical examination textbooks available in medical libraries and bookstores. In addition, an increasing number of hands-on continuing education physical assessment courses are available for pharmacists.

The Process

The physical examination, usually conducted from the patient's right side, follows a generally accepted sequence that minimizes the number of changes in position by the patient and clinician (Box 4-1). It is important to respect the patient's privacy and minimize patient discomfort and embarrassment throughout the examination. The scope of the examination varies depending on the patient's illness and its severity. A thorough and detailed examination of all organ systems is required for a severely ill patient with multiple complaints; subsequent examinations may target specific organ systems, with perfunctory assessment (if any) of other organ systems. The usual neurologic examination is a simple screening examination unless otherwise indicated.

Box 4-1.
Usual Physical Assessment Sequence

- 1. Vital signs
- 2. Appearance and behavior
- 3. Skin
- 4. Head
- 5. Eyes
- 6. Ears
- 7. Nose
- 8. Mouth
-

9. Neck
- 10. Breasts
- 11. Chest and lungs
- 12. Heart
- 13. Abdomen
- 14. Extremities
- 15. Back and spine
- 16. Nervous system
- 17. Mental status
- 18. Genitalia and rectum

Inspection, Palpation, Percussion, and Auscultation Techniques

The physical examination consists of a detailed patient evaluation using the four fundamental techniques of inspection, percussion, palpation, and auscultation (IPPA). All four techniques are used to assess the patient, although not every organ system is evaluated using all four techniques.

Inspection denotes visual surveillance. Observe the patient's breathing, gait, clothing, personal grooming, body habitus (physical characteristics), body position (e.g., sitting comfortably, shifting uncomfortably in pain, leaning forward with chin propped up on hands), affect (mood), and appropriateness of the patient's affect to the situation. Inspect the skin for color and the presence of lesions, visible trauma, or other abnormalities.

Percussion is a technique to assess the density of underlying structures. A percussion note is created by either tapping the patient's body directly with the distal end of a finger (direct percussion) or by tapping the examiner's finger (indirect percussion) (Figure 4-1). For indirect percussion, place the hand flat on the surface of the patient's body. Raise up the hand and fingers so that only the finger that is going to be tapped touches the patient. Then tap the middle phalanx between the distal interphalangeal joint and the proximal interphalangeal joint with the ends (not

pads) of the fingers. With indirect percussion, it is important to touch the patient only with the finger that is being tapped; this creates the most clear percussion note and avoids dampening the vibrations with the palm or rest of the fingers on the hand. Another indirect percussion technique is to tap the middle phalanx with the rubber head of a reflex hammer. Hold the reflex hammer as if hammering a nail and tap briskly.

Full-size image (55K)
Figure 4-1.

Percussion.

A, Technique for indirect percussion. Only the pleximeter finger touches the patient. Hand position before **B** and after **C,** striking the pleximeter finger.

(From Swartz MH: *Textbook of physical diagnosis: history and examination,* ed 6, St Louis, 2004, Mosby.)
The resultant sound is described as one of four percussion “notes”: resonant, dull, tympanic, and flat. In health, each of these four percussion notes is elicited over specific areas of the body, but with disease they may be elicited over other areas of the body. A resonant percussion note, described as a hollow sound, is normally elicited over healthy lung. Percussion over a healthy liver produces a dull percussion note. A tympanic percussion note, described as a drumlike sound, is elicited over the stomach. Percussion over large muscles such as a thigh muscle produces flat percussion notes.

Palpation consists of using the hands to feel areas that cannot be seen; palpation can be performed with the fingertips, palm, or back of the hand (Figure 4-2). Palpation may be superficial (light touch) or deep. Use the back of the hand to assess skin temperature, superficial palpation with the fingertips to assess the point of maximal impulse, and deep palpation with the fingertips to feel the lower edge of the liver and the spleen tip.

Full-size image (57K)
Figure 4-2.

Palpation.

A, Light palpation; press in 1 cm or less. **B,** Deep palpation; press in deeply. **C,** Palpation for temperature; lightly touch the patient with the back of the hands.

(From Seidel HM: *Mosby's guide to physical examination*, ed 7, St Louis, 2011, Mosby.)
Auscultation consists of listening either directly with the ear or indirectly with the aid of a device (typically a stethoscope) to sounds that arise spontaneously from the body (e.g., breath sounds, heart sounds, bowel sounds, bruits). The diaphragm or bell of the stethoscope is placed directly on the skin, never over clothing. The diaphragm is placed so that the entire surface of the diaphragm is held firmly in contact with the skin. The bell is placed lightly on the skin.

Equipment

Several pieces of equipment are required for the physical examination (Table 4-2). Physical assessment equipment is available in many price ranges. In general, pharmacists should invest in decent equipment and avoid the lowest priced equipment, which may be poorly engineered and harder to use.

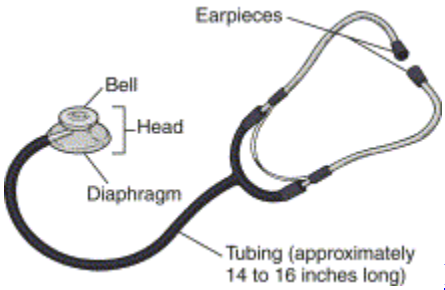
Table 4-2. Physical Assessment Equipment

Equipment	Purpose
Flashlight	Assess pupillary reflexes; aid in inspection of the oropharynx and skin
Ophthalmoscope	Perform funduscopic examination
Otoscope	Assess external ear canal and tympanic membrane
Tongue depressor	Inspect oropharynx
Watch (digital or sweep second hand)	Assess heart and respiratory rate
Thermometer	Measure body temperature
Stethoscope	Assess cardiovascular, pulmonary, and abdominal systems
Sphygmomanometer	Measure blood pressure
Reflex hammer	Assess neurologic function
Tuning fork	Assess neurologic function

Stethoscope

The stethoscope, an important auscultatory tool, consists of two earpieces angled at the same angle as the ear canal, rubber tubing, and a head with either a diaphragm (plastic disc) or a bell (hollow cup) (Figure 4-3). The diaphragm accentuates high-frequency sounds; the bell transmits low-frequency sounds (Figure 4-4). Dual-headed stethoscopes have both a diaphragm and a bell. Some stethoscopes have only a diaphragm (no bell); some stethoscopes have a pressure-sensitive tunable head that functions as both a diaphragm and bell depending on the applied pressure. Stethoscopes are available in a variety of styles (Figure 4-5) and price ranges, including electronically amplified stethoscopes. Although the choice of style (e.g., Sprague-Rappaport type

with dual tubing, Littman type with a single tube) depends on personal preference, quality is important. Higher-quality stethoscopes transmit sounds more efficiently and are more durable than cheaper models. The earpieces should fit the ear canals snugly and comfortably; the goal is for the sound to be transmitted from the patient to the eardrum through an unbroken system. Most high-quality stethoscopes come with several different sizes and shapes of ear tips, which enables the user to select the best-fitting and most comfortable tips.



Full-size image (20K)

Figure 4-3.

The Stethoscope.

Full-size image (40K)

Figure 4-4.

Stethoscope Head.

A, Diaphragm. **B,** Bell.

(From Swartz MH: *Textbook of physical diagnosis: history and examination*, ed 6, St Louis, 2004, Mosby.)

Full-size image (26K)

Figure 4-5.

Stethoscope Types.

A, Single tube. **B,** Double tube.

(From Sanders MJ: *Mosby's paramedic textbook,* ed 3, St Louis, 2006, Mosby.)

Sphygmomanometer

The sphygmomanometer includes a cuff (a cloth-covered inflatable rubber bladder), a valved rubber bulb for inflating the cuff, and a manometer that measures the cuff pressure. Blood pressure cuffs (Figure 4-6) come in a variety of sizes to accommodate a variety of arm sizes (Table 4-3).[1] Use an appropriately sized cuff; cuffs that are too short or too narrow falsely elevate the blood pressure, whereas cuffs that are too big falsely decrease the blood pressure. The cuff width should be about 40% of the limb circumference, and the cuff length should be about 80% of the limb circumference. There are two types of manometers: the classic wall-mounted mercury-filled glass tube and the aneroid dial (Figure 4-7). Mercury-based manometers are durable, are easy to read, and provide consistent, accurate measurements but are bulky and must be in an upright position and at eye level for accurate measurements. Mercury is a hazardous substance; many health care professionals prefer to use aneroid manometers, which do not contain mercury. Aneroid manometers are relatively inexpensive and work in all positions but are delicate and must be recalibrated if bumped or dropped. There are also a variety of automatic digital manometers.

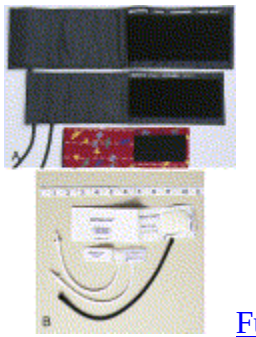

Full-size image (34K)

Figure 4-6.

Blood Pressure Cuffs.

A (from top), Large adult, adult, and child cuffs. **B** (from top), Infant and neonatal cuffs.

(From Seidel HM: *Mosby's guide to physical examination*, ed 7, St Louis, 2011, Mosby.)

Table 4-3. Blood Pressure Cuff Sizing

Cuff	Arm Circumference Range at Midpoint (cm)
Newborn	≤6
Infant	6-15
Child	16-21
Small adult	22-26
Adult	27-34
Large adult	35-44
Adult thigh	45-52

Full-size image (31K)

Figure 4-7.

Sphygmomanometers.

Mercury-based (*left*) and aneroid (*right*) sphygmomanometers.

(From Gerdin J: *Health career today*, ed 4, St Louis, 2007, Mosby.)

Ophthalmoscope

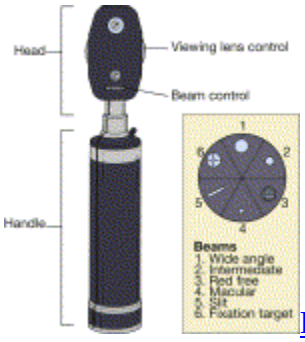
The ophthalmoscope consists of a head and a handle (Figure 4-8 and Figure 4-9). The head contains viewing lenses and beam selection controls. The viewing lens control (lens wheel) is used to focus the instrument. Positive diopter values (black or green numbers depending on the manufacturer) are used to correct the focal length for nearsighted eyes; negative diopter values (red numbers) are used to correct the focal length for farsighted eyes. The beam control wheel is used to select the aperture (beam); aperture selection depends on the structure being assessed (Table 4-4). The light intensity is adjustable on some ophthalmoscopes.

Full-size image (21K)

Figure 4-8.

The Ophthalmoscope.

(From Sanders MJ: *Mosby's paramedic textbook,* ed 3, St Louis, 2006, Mosby.)



Full-size image (27K)

Figure 4-9.

Components of the Ophthalmoscope.

Table 4-4. Ophthalmoscope Apertures

Aperture	**Use**
Large white (wide angle)	Assess dilated pupils
Intermediate white	Assess undilated pupils and details of small areas
Small white	Assess undilated pupils and details of small areas
Red-free (bluish green filter)	Assess retinal vessels and hemorrhages (red appears black on a greenish background instead of the usual red on orangish background with white light)
Macular	Assess macula
Slit	Assess cornea, anterior chamber, and elevations or depressions in the fundus
Fixation	Locate lesions and measure eccentric fixation

Otoscope

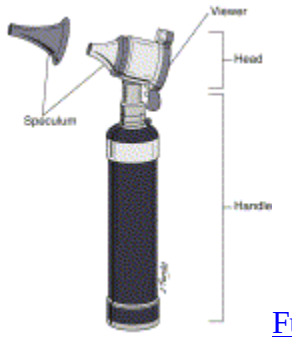
The otoscope consists of a head and a handle (Figure 4-10 and Figure 4-11). The otoscope is used to assess the ear canal and tympanic membrane. The head consists of a speculum and magnifying glass and can be rotated up and down into several positions. Disposable speculum covers are available in a variety of sizes to fit most ear canals. Most otoscopes and ophthalmoscopes are available as interchangeable heads that fit the same handle.

Full-size image (31K)

Figure 4-10.

The Otoscope.

(From Jarvis C: *Physical examination and health assessment,* ed 5, St Louis, 2008, Saunders.)



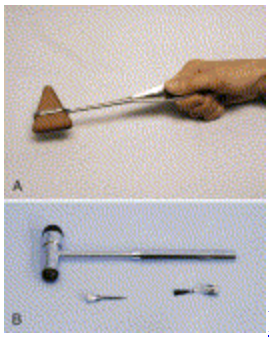
Full-size image (19K)

Figure 4-11.

Components of the Otoscope.

Reflex Hammer

The reflex hammer, also known as a *percussion hammer,* consists of a rubberlike head attached to a handle (Figure 4-12). The reflex hammer primarily is used to elicit superficial and deep tendon reflexes but may be used to create percussion notes (e.g., in chest percussion). The Taylor, or tomahawk-style, reflex hammer has a triangular head. Several other styles are available. Generally the pointed end of the head of the reflex hammer is used to strike the tendon and elicit the reflex.



Full-size image (26K)
Figure 4-12.

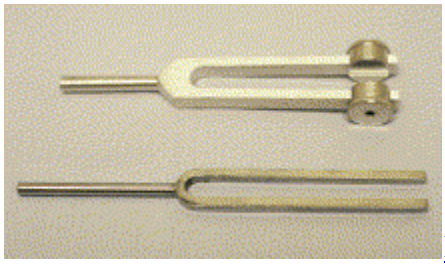
Reflex Hammers.

A, Tomahawk-style hammer. **B,** Neurologic hammer.

(From Seidel HM: *Mosby's guide to physical examination*, ed 6, St Louis, 2006, Mosby.)

Tuning Fork

Tuning forks, typically aluminum, consist of a stem (handle) and two prongs that form a U-shaped fork (Figure 4-13). The tuning fork vibrates at a set frequency after being struck on the heel of the hand and is used to assess vibratory sensation and hearing (air conduction and bone conduction). Hold the tuning fork by the stem, not the prongs. Tuning forks are available in a wide range of frequencies (64 Hz to 4096 Hz); 128 Hz is a commonly used frequency for screening.


Full-size image (12K)
Figure 4-13.

Tuning Forks.

Tuning forks for vibratory sensation (Top) and auditory testing (Bottom).

(From Seidel HM: *Mosby's guide to physical examination*, ed 7, St Louis, 2011, Mosby.)

Other Equipment

Other useful equipment includes a light source (penlight or flashlight) and tongue depressors. The light source is used to assess pupillary response to light and to facilitate closer observation of other visible features (e.g., skin lesions, carotid artery pulsations). Tongue depressors, used to facilitate inspection of the oropharynx, are made of wood and are available in individual (sterile)

peel-down pouches or in nonsterile bulk packaging. The standard adult tongue depressor is 6 × 11⁄16 inches. Other sizes are available (junior, 5 1⁄2 × 5⁄8 inches; infant, 4 1⁄2 × 3⁄8 inches). A sterile tongue depressor broken in half is sometimes used to test the neurologic response to a sharp stimulus.

Vital Signs

The vital signs include the heart rate, respiratory rate, blood pressure, and temperature. Along with height and weight, the vital signs provide important screening and diagnostic information as well as monitoring data for assessment of short-term and long-term response to medication therapy.

Techniques

Arterial Pulse

To assess the arterial pulse, determine the heart rate, the strength of the pulse, and the regularity of the pulse (Box 4-2). The radial artery is commonly used to assess pulse, although any accessible large artery (e.g., femoral, carotid) may be used (Figure 4-14). The radial artery is located in the wrist below the thumb and between the flexor carpi radialis and abductor pollicis longus tendons. Gently compress the artery with the fingertips; do not palpate with the thumb (the pulse in the examiner's thumb may confuse the assessment of the patient's pulse). Determine the number of heartbeats per minute (beats/min, BPM) by counting the number of pulses in 15 seconds and multiplying by 4 (or use any combination that gives the per-minute rate). The strength of the pulse is described as "normal," "weak," or "bounding" (stronger than normal). Determine if the pulse is regular (evenly spaced beats) or irregular (unequally spaced beats). If irregular, determine if the sequence has a repeating pattern (regularly irregular) or not (irregularly irregular).

Box 4-2.
Arterial Pulse Checklist

- □ Locate the radial pulse.
- □ Palpate with the fingers (not thumb).
- □ Report/record the per-minute rate. (Example: The heart rate is 80 beats per minute.)
- □ Report/record the strength. (Example: The pulse is normal strength.)
-

□ Report/record the regularity. (Example: The pulse is regular.)

Full-size image (22K)
Figure 4-14.

Arterial Pulse.

(From Seidel HM: *Mosby's guide to physical examination*, ed 7, St Louis, 2011, Mosby.)
The normal heart rate is approximately 60 to 100 beats/min with normal strength and regular beats. Bradycardia, a slow heart rate (<60 beats/min), is caused by medications such as beta-adrenergic blocking drugs and digoxin and by sinus node or atrioventricular (AV) node dysfunction. Tachycardia, a fast heart rate (>100 beats/min), is caused by anxiety, volume depletion, fever, exercise, and inotropic drugs such as epinephrine and dobutamine. A weak pulse is caused by conditions associated with decreased cardiac output (e.g., heart disease, hypovolemia). A strong (bounding) pulse is caused by conditions associated with increased cardiac output (e.g., anxiety, pain, hyperthyroidism). The heart rate is normally regular, with evenly spaced beats. An irregular heart rate, characterized by irregularly spaced beats, may be completely irregular (no identifiable pattern) or regularly irregular (repetitive abnormal pattern). Cardiac dysrhythmias are commonly associated with irregular heartbeats.

Respiration

Unobtrusively observe the patient breathe (a patient aware of being watched will control his or her breathing) (Figure 4-15). Determine the per-minute respiratory rate, the pattern of breathing, and whether the patient is using accessory muscles to breathe (Box 4-3). One technique for observing the patient's respiration unobtrusively is to position the patient so that the patient's chest can be observed while the pulse is assessed. Continue to hold the patient's wrist and watch the clock after completing the assessment of the pulse but count the respiratory rate. Note that one breath equals one respiratory cycle (inspiration plus expiration). Determine the number of breaths per minute (breaths/min, BPM) by counting the number of breaths in 15 seconds and multiplying by 4 (or use any combination that gives the per-minute rate). Observe whether the pattern of breathing is normal (normal depth of breathing and regular rate) or abnormal (shallow, deep, shallow then deep, periodic apnea, etc.) and note whether the patient is using the sternocleidomastoid and/or abdominal muscles (transverse, oblique) to assist the breathing.

Full-size image (32K)
Figure 4-15.

Counting Respirations.

When counting respirations, leave the hands in place as if still assessing the patient's pulse.

(From Young A: *Kinn's the medical assistant: an applied-learning approach,* ed 10, St Louis, 2007, Saunders.)
Box 4-3.
Respiration Checklist

- □ Unobtrusively observe the patient's breathing.
- □ Report/record the rate. (Example: The respiratory rate is 12 breaths per minute.)
- □ Report/record the pattern. (Example: The respiratory pattern is normal.)
- □ Report/record the use of accessory muscles. (Example: No accessory muscles used.)

The normal respiratory rate is 12 to 20 breaths/min. Tachypnea, a fast respiratory rate (>20 breaths/min), is caused by pain, anxiety, exercise, and respiratory failure. Bradypnea, a slow respiratory rate (<12 breaths/min), is caused by medications such as narcotics and medical conditions associated with elevated carbon dioxide levels. The respiratory rate is normally regular, with evenly spaced inspirations and expirations, and of normal tidal volume (volume per breath). Abnormal breathing patterns include abnormally fast and deep breathing (Kussmaul's respiration; associated with metabolic acidosis), fast and shallow breathing (associated with obstructive airway disease), slow and shallow breathing (associated with narcotics), apnea (no breathing; associated with sleep apnea), and Cheyne-Stokes breathing (periods of apnea alternating with cycles of increasing and decreasing depth of breathing; associated with diseases that affect the central respiratory control center) (Figure 4-16).

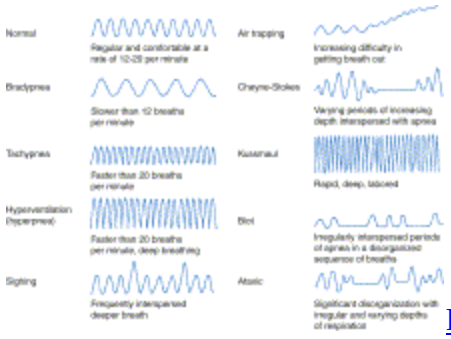

Normal
Regular and comfortable at a rate of 12-20 per minute
Air trapping
Increasing difficulty in getting breath out
Bradypnea
Slower than 12 breaths per minute
Cheyne-Stokes
Varying periods of increasing depth interspersed with apnea
Tachypnea
Faster than 20 breaths per minute
Kussmaul
Rapid, deep, labored
Hyperventilation (hyperpnea)
Faster than 20 breaths per minute, deep breathing
Biot
Irregularly interspersed periods of apnea in a disorganized sequence of breaths
Sighing
Frequently interspersed deeper breath
Ataxic
Significant disorganization with irregular and varying depths of respiration
Full-size image (77K)

Figure 4-16.

Respiratory Patterns.

Vertical lines indicate depth of respiration. Horizontal lines indicate the relative respiratory rate.

(From Seidel HM: *Mosby's guide to physical examination*, ed 7, St Louis, 2011, Mosby.)

Blood Pressure

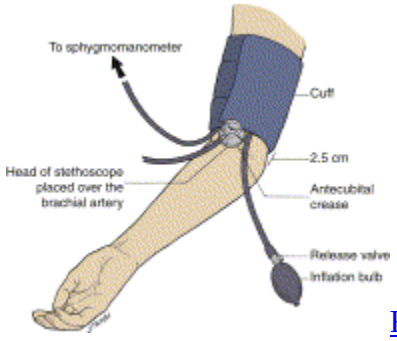
Patients should be at rest for at least 15 minutes before the blood pressure is measured, and if the patient is sitting, the patient's feet should be flat on the floor (the blood pressure will be falsely high if the legs dangle) (Box 4-4). Select an appropriately sized cuff and palpate for the brachial artery before positioning the cuff on the arm. Place the arterial portion of the cuff directly over the brachial artery with the bottom of the edge approximately 2.5 cm above the antecubital crease (Figure 4-17). Support the patient's arm at the level of the heart; tensed muscles falsely elevate the blood pressure (the blood pressure will be falsely high if the arm is below the level of the heart and falsely low if the arm is above the level of the heart) (Figure 4-18).

Box 4-4.
Blood Pressure Checklist

- □ Make sure the patient has both feet flat and supported on the ground.
- □ Ask the patient if the patient knows his or her blood pressure.
- □ Palpate for the brachial pulse before putting the cuff on the patient's arm.
- □ Align the cuff with the brachial artery.
- □ Position the bottom of the cuff 2.5 cm above the antecubital crease.
-

□ Place the diaphragm of the stethoscope over the brachial artery.

- □ Support the patient’s arm at the level of the heart.
- □ Close the valve on the bulb and pump the cuff to 20 mm Hg over the expected systolic blood pressure.
- □ Open the valve and slowly release the pressure at a rate of 2-4 mm Hg/sec.
- □ Deflate and remove the cuff.
- □ Report/record the systolic and diastolic pressures. (Example: The blood pressure is 120 over 80 mm Hg.)



Full-size image (30K)

Figure 4-17.

Blood Pressure Cuff Position.

Full-size image (39K)

Figure 4-18.

Blood Pressure Technique.

Support the arm at the level of the heart.

(From Jarvis C: *Physical examination and health assessment*, ed 5, St Louis, 2008, Saunders.)
Place the stethoscope over the brachial artery and inflate the cuff to about 20 to 30 mm Hg over the predicted systolic blood pressure (SBP). Deflate the cuff slowly (approximately 2 mm Hg/sec) (SBP will be falsely low and the diastolic blood pressure [DBP] falsely high if the deflation rate is too fast; the DBP will be falsely high if the deflation rate is too slow). Do not reinflate the cuff after partial deflation; cuff reinflation causes venous congestion and inaccurate blood pressure measurements. There are no audible sounds (Korotkoff sounds) until the cuff pressure approximates the SBP; the SBP is the pressure at which at least two Korotkoff sounds are audible.

Korotkoff sounds (tapping sounds) are created by turbulent flow through the partially occluded artery. Each heartbeat creates a sound as the bolus of blood encounters the partially occluded artery; the tapping sound varies with the degree of arterial occlusion (Table 4-5). As the pressure falls, the sounds become louder and then slowly diminish before disappearing altogether. The DBP is the pressure at which the beats are not longer audible. The tapping sounds may disappear during phase II or III (see Table 4-5) and then reappear as the arterial pressure falls. This is called an *auscultatory gap* and is sometimes observed in elderly patients and hypertensive patients. Depending on the clinical situation, it may be necessary to obtain the blood pressure in both arms or in more than one body position (i.e., sitting and standing, sitting and supine).

Table 4-5. Korotkoff Sounds

Phase	**Description**
Phase I	First clear, low-pitched tapping sounds (onset corresponds with systolic blood pressure)
Phase II	Softer and longer tapping sounds
Phase III	Reappearance of crisp and clear tapping sounds
Phase IV	Muffled softer tapping sounds
Phase V	Sounds disappear (last audible tapping sound corresponds with the diastolic blood pressure)

Normal blood pressure is defined as an SBP of less than 120 mm Hg and a DBP of less than 80 mm Hg (Table 4-6).[2] The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) defines hypertension for adults 18 years of age and older as beginning at 140/90 mm Hg based on the average of two or more proper measurements at each of two or more office or clinic visits.[2] Patients may have isolated systolic hypertension (SBP ≥140 mm Hg with DBP <90 mm Hg) or isolated diastolic hypertension (SBP <140 mm Hg with DBP ≥90 mm Hg).

Table 4-6. Blood Pressure Classification

From Chobanian AV, Bakis GL, Black HR, et al: The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. *Hypertension* 42:1206-1252, 2003.

Classification*	Systolic Blood Pressure (mm Hg)	Diastolic Blood Pressure (mm Hg)
Normal	<120	<80
Prehypertension	120-139	80-89
Stage 1 hypertension	140-159	90-99
Stage 2 hypertension	≥160	≥100

* Classification is determined by the higher of the systolic blood pressure and diastolic blood pressure.

Temperature

Body temperature is used to screen for illness and to monitor patient response to drug therapy. The measured temperature varies depending on where the body temperature is measured (oral cavity, rectum tympanic membrane, axilla, ear, temporal artery, central line, bladder) and the device used to measure the temperature (oral thermometer, temperature-sensitive crystal, thermal scanner, thermistor on pulmonary artery catheter, etc.) (Figure 4-19). Other variables include the time of day and probably the patient's gender (gender differences have been described, but specific guidelines are not currently available). Oral temperature measurements are influenced by drinking hot and cold beverages and chewing gum. The core body temperature as measured by inserting a pulmonary artery catheter with a thermistor into the pulmonary artery is considered the gold standard body temperature, but this technique is too invasive for routine assessments. Digital thermal scanning thermometers are quick and easy to use but rely on proprietary predictive algorithms and are therefore less accurate than other technologies. Record the temperature, date and time of day, and route and instrument used to obtain the temperature.

Full-size image (85K)

Figure 4-19.

Thermometers.

1. Glass thermometers: a, oral axillary (long slender tip), b, rectal (stubby tip), c, oral axillary (pear-shaped tip). **2.** Digital thermometer. **3.** Disposable thermometer. **4.** Electronic thermomenter. **5.** Tympanic thermometer. **6.** Temperature-senstive tape. **7.** Temporal artery thermometer.

(From Sorrentino S, Gorek B: *Mosby's textbook for long-term care nursing assistants*, ed 5. St Louis, 2007, Mosby.)
Normal oral body temperature is 37° C (98.6° F).[3] Fever is generally accepted to be an oral body temperature of 38° C (100.4° F) or higher. Oral body temperature is 1° lower than rectal body temperature and axillary temperature is 2° lower than rectal body temperature.

Height and Body Weight

The patient's height and body weight are not considered vital signs but are useful screening and monitoring parameters and are components of the body mass index (BMI) equation:BMI(metric)=weight in kilograms÷^{2}(height in meters) $$BMI_{(English)} = \frac{(\text{weight in pounds} \times 703)}{(\text{height in inches})^2}$$

The waist circumference and waist/hip ratio (WHR) are additional screening and monitoring parameters (WHR = waist circumference ÷ hip circumference). The waist circumference is measured at the narrowest part of the waist. The hip circumference is measured at the widest part of the hips. For both measurements, keep the tape measure parallel to the ground.

The BMI (Table 4-7) assesses body fat and, when considered with waist circumference, WHR, and other risk factors (hypertension, increased low-density lipoprotein cholesterol [LDL-C], decreased high-density lipoprotein cholesterol [HDL-C], increased triglycerides, elevated blood glucose level, family history of cardiac disease, physical inactivity, and cigarette smoking) is predictive of coronary heart disease and cardiovascular mortality.[5] But BMI underestimates body fat in people with less muscle mass than normal (e.g., the elderly), overestimates body fat in people with more muscle mass than normal (e.g., athletes), and does not provide information regarding fat distribution, an important determinant of risk for several diseases, including coronary heart disease, metabolic syndrome, and obstructive sleep apnea. Abdominal fat is assessed by measuring the waist circumference and the WHR (Figure 4-20). A waist circumference of more than 40 inches in men and more than 35 inches in women is associated with increased risk for cardiovascular and metabolic disease. A WHR of less than 0.85 for men and less than 0.75 for women is considered excellent and is associated with low risk; WHRs of 1 or higher are associated with increased risk.

Table 4-7. Body Mass Index (BMI) Classification[4]
From: Screening for Obesity in Adults. What's New from the USPSTF? AHRQ Publication No. 04-IP002, Rockville, Md, December 2003, Agency for Healthcare Research and Quality. Available at: http://www.ahrq.gov/clinic/3rduspstf/obesity/obeswh.htm. Accessed November 20, 2009.

Classification	**BMI**
Underweight	<18.5
Normal weight	18.5-24.9
Overweight	25-29.9
Class I obesity	30-34.9
Class II obesity	35-39.9
Class III obesity	≥40

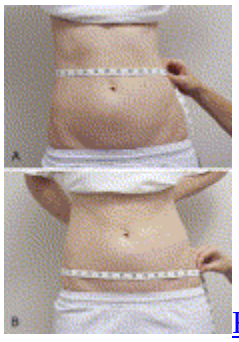

Full-size image (32K)

Figure 4-20.

Waist/Hip Ratio.

Waist/hip ratio equals waist circumference (**A**) divided by hip circumference (**B**).

(From Seidel HM: *Mosby's guide to physical examination*, ed 7, St Louis, 2011, Mosby.)

Terminology

- **abdominal respiration:** Respiration effected primarily by movement of the abdominal muscles
- **apnea:** Absence of respiration
- **auscultatory gap:** The silent interval that sometimes occurs in phase II and III (see Table 4-5) in elderly patients and patients with hypertension
- **Biot's respiration:** Irregular respiration; may occur in meningitis
- **body mass index (BMI):** A measure of body adiposity
- **bradycardia:** A slow (<50 beats/min) heart rate
- **bradypnea:** Abnormally slow respiratory rate with regular rhythm and normal depth of breathing; associated with central nervous system depressants and elevated intracranial pressure

Cheyne-Stokes respiration: A cyclic, abnormal respiratory pattern characterized by a gradual increase in the depth and rate of respiration followed by a gradual decrease in the depth and rate ending in apnea; characteristic of diseases that affect the central respiratory centers

- **eupnea:** Normal respiration
- **hyperpnea:** Increased depth and rate of respiration
- **hypertension:** Elevated blood pressure
- **hypotension:** Low blood pressure
- **Korotkoff sounds:** Tapping sounds heard over the artery when blood pressure is taken by the ausculatory method
- **Kussmaul's respiration:** Deep, rapid respiration; characteristic of coma and diabetic ketoacidosis
- **orthostatic hypotension:** A fall in SBP of 15 mm Hg or more when the patient assumes a more upright position
- **pulse, bounding:** A stronger than normal pulse
- **pulse, irregular:** Pulse characterized by unevenly spaced beats
- **pulse, regular:** Pulse characterized by evenly spaced beats
- **pulse, regularly irregular:** Pulse characterized by a repeating pattern of unevenly spaced beats
- **pulse, weak:** A weaker than normal pulse

pulsus alternans: Regular alteration of strong and weak pulse beats; associated with heart failure

- **pulsus paradoxus:** Decreased SBP with inspiration; normally the decrease is about 5 mm Hg
- **tachycardia:** A rapid (>100 beats/min) heart rate
- **tachypnea:** Increased respiratory rate
- **waist/hip ratio (WHR):** A measure of abdominal fat

Skin

Techniques

The skin is evaluated using inspection and palpation. Dermatologic findings must be interpreted in the context of the medications the patient is taking and the time course of the reaction or response (or lack of response) to a medication. For example, a thorough and detailed medication history is essential in assessing drug-associated dehydration or persistent peripheral edema in patients with congestive heart failure who are potentially nonadherent with the prescribed drug regimen. For assessment of suspected drug-related dermatologic reactions, it is important to know when the medication was started, the distribution of the skin lesions, any prelesion systemic symptoms (e.g., malaise, fever), and the time course of the progression of the skin lesions. For example, toxic epidermal necrolysis is characterized by a prodrome of fever and malaise followed by widely distributed erythematous or purpuric macules and plaques that progress to blistering and full-thickness epidermal necrosis.

Inspection

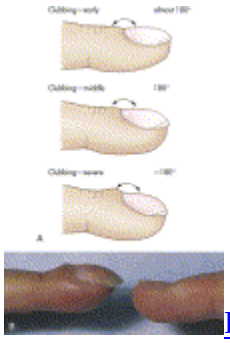
Make sure the lighting is good; use a flashlight or penlight for close visualization of lesions and other abnormalities. Inspect the skin for color (pallor, cyanosis, redness, yellowness) (Figure 4-21), lesions, trauma, or other abnormalities. Inspect the nails and nail beds for clubbing (Figure 4-22), cyanosis, or trauma. Note the distribution, amount, and texture of the body hair. Describe lesions according to location, type, color, shape, size, grouping, and pattern. Note whether the lesions are present on the palms of the hands, the soles of the feet, and the mucous membranes (oropharyngeal, ocular, genital). Note whether the lesions are limited to sun-exposed skin or are more widespread.

Full-size image (71K)
Figure 4-21.

Skin Inspection.

A, Pallor. **B,** Jaundice. **C,** Erythema.

(**A,** From Hoffbrand AV, Pettit JE, Vyas P: *Color atlas of clinical hematology*, ed 4, Philadelphia, 2010, Mosby. **B,** From Kockrow **C,** Christensen B: *Adult health nursing*, ed 5, St Louis, 2006, Mosby. C, From Swartz MH: *Textbook of physical diagnosis: history and examination*, ed 6, St Louis, 2004, Mosby.)


Full-size image (35K)
Figure 4-22.

Clubbing.

A, Early, moderate, and severe clubbing. **B,** Late-stage clubbing.

(From Seidel HM: *Mosby's guide to physical examination*, ed 7, St Louis, 2011, Mosby.)

Palpation

Palpate the skin for turgor (hydration status), moistness, temperature (warm, cool), texture (rough, smooth), thickness (thick, thin), mobility (immobile, mobile, hypermobile), and edema. Assess skin turgor by pulling up and quickly releasing a fold of skin (Figure 4-23). In a well-hydrated patient, the skin quickly returns to normal; it takes longer for the skin to return to normal if the patient is dehydrated (tenting). Assess edema by pressing the tips of one or two fingers into the skin and noting how long the indentation remains after the fingers are removed (Figure 4-24). A plus scale (1+, 2+, 3+, 4+) is used to quantify the edema, with 4+ denoting the most long-lasting indentations.

Full-size image (22K)

Figure 4-23.

Testing Skin Turgor.

(From Seidel HM: *Mosby's guide to physical examination*, ed 7, St. Louis, 2011, Mosby.)

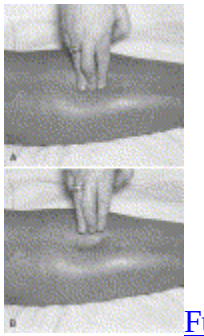

Full-size image (38K)

Figure 4-24.

Testing Peripheral Edema.

Press fingers into shin (**A**); indentations remain with pitting edema (**B**).

(From Swartz MH: *Textbook of physical diagnosis: history and examination*, ed 6, St Louis, 2004, Mosby.)

Terminology

Fingernail and Toenail Terms

- **Beau's lines:** Transverse horizontal depressions associated with severe illness
- **clubbing:** Increased angle (>180 degrees) between the base of the nail and nail bed; associated with chronic arterial desaturation (e.g., chronic obstructive pulmonary disease [COPD])
-

koilonychias: Spooning of the nails; associated with iron deficiency anemia

- **onycholysis:** Separation of the nail from the nail bed; associated with trauma, malnutrition, and thyroid disease
- **splinter hemorrhages:** Red or brown linear streaks in the distal extremity of the nail bed; nonspecific

Lesions, Primary

- **bulla:** A large (>1 cm), circumscribed, elevated lesion containing serous fluid, such as blistering from second-degree burns
- **ecchymosis:** A large (>1 cm) hemorrhage, commonly known as a *bruise*
- **macule:** A small (<1 cm), circumscribed, flat, discolored lesion, such as a freckle or flat nevus
- **nodule:** A large (>1 cm), solid lesion that may be below, even with, or above the surface of the skin
- **papule:** A small (<1 cm), elevated, solid lesion, such as a wart
- **patch:** An area containing discolored, circumscribed, and flat or elevated groups of lesions, such as a measles rash
- **petechia:** A small (<2 mm) hemorrhage
- **plaque:** A large (>1 cm), circumscribed, elevated, and solid lesion, such as in pityriasis rosea
- **pustule:** A circumscribed, elevated lesion of varying size containing pus, such as in impetigo

vesicle: A small (<1 cm), circumscribed, elevated lesion containing serous fluid, such as in herpes zoster

- **wheal:** An edematous and transitory papule; also called *hive*

Lesions, Secondary

- **crust:** A mass of dried exudates, such as in impetigo
- **excoriation:** A scratch mark usually covered with blood or serous crusts
- **fissure:** A linear break in the skin
- **keloid:** A hypertrophic scar
- **lichenification:** Thickening and roughening of the skin with increased visibility of normal skin lines
- **scale:** Dead epidermal cells, such as dandruff
- **scar:** Area in which normal skin tissue has been replaced by connective tissue
- **ulcer:** An irregularly sized and shaped excavation that extends below the dermal skin layer, such as a pressure sore

Lesions, Other

- **comedo (blackhead):** A pilosebaceous follicular plug of sebaceous and keratinous material
- **milium (whitehead):** A small (1 to 2 mm) nodule with no visible opening
- **nevus (mole):** A flat or elevated pigmented lesion
-

Osler's node: A small, raised, discolored, tender lesion on the pads of the fingers and toes associated with bacterial endocarditis

- **telangiectasias:** Dilated superficial blood vessels

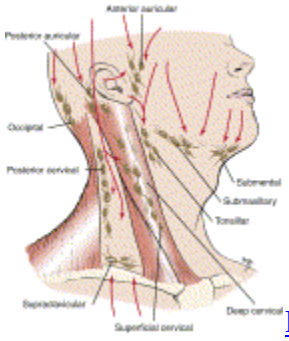
Head and Neck

Techniques

The structures of the head and neck (skull, scalp, face, neck, nose, ears, mouth and pharynx, and eyes) are evaluated through inspection and palpation; percussion and auscultation are rarely indicated. Visual acuity, hearing, and facial and ophthalmic reflexes are tested when clinically indicated.

Inspection

- **Skull:** Inspect the skull for size, contour, shape, and evidence of trauma.
- **Hair:** Inspect the hair for quantity, texture, and distribution.
- **Scalp:** Inspect the scalp for lesions and scales.
- **Face:** Inspect the face for expression, symmetry, movement, lesions, and edema.
- **Neck:** Inspect the neck for symmetry, masses, and enlargement of the parotid and submaxillary glands and lymph nodes (Figure 4-25). Note the position and size of the sternomastoid muscles and the carotid arteries and the position of the trachea.



Full-size image (58K)

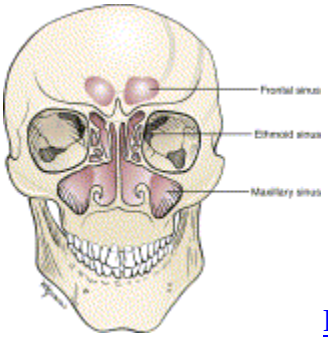
Figure 4-25.

Head and Neck Lymph Nodes.

Lymph nodes are located in several regions of the head and neck.

(From Swartz MH: *Textbook of physical diagnosis: history and examination*, ed 6, St Louis, 2004, Mosby.)

- **External nose and nasal cavity:** Inspect the external nose and nasal cavity for symmetry, inflammation, and lesions.
- **Sinuses:** Transilluminate the maxillary sinuses (Figure 4-26) by shining a bright light in the mouth. Normal maxillary sinuses appear as dull-red crescent-shaped glowing areas under each eye. Transilluminate the frontal sinuses (see Figure 4-26) by placing a light source under the medial aspect of each eyebrow. Normal frontal sinuses appear as glowing red areas above each eye. Fluid-filled sinuses (e.g., in sinusitis) glow less.



Full-size image (48K)

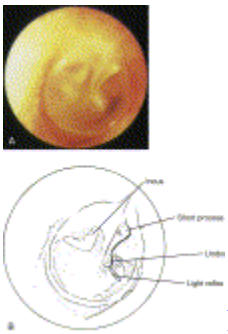
Figure 4-26.

Nasal Sinuses.

(From Swartz MH: *Textbook of physical diagnosis: history and examination*, ed 6, St Louis, 2004, Mosby.)

- **External ear:** Inspect the external ear for lesions, trauma, size, and contour.
- **Ear canal and tympanic membranes:** Inspect the ear canal and tympanic membranes with the otoscope. Insert the otoscope by tipping the patient's head slightly to the opposite side and gently pulling the auricle up, back, and slightly outward (movement of the auricle and tragus is painful in acute otitis externa). Inspect the canal for foreign bodies (e.g., insects, pieces of toys), discharge (note color), and edema. Inspect the tympanic membrane (Figure 4-27) for color, bulging, perforations, and air-fluid level (an

obvious fluid meniscus behind the membrane). An air-fluid level is associated with middle ear infections.



Full-size image (43K)

Figure 4-27.

Tympanic Membrane.

Normal right tympanic membrane. **A,** Photograph. **B,** Schematic.

(From Swartz MH: *Textbook of physical diagnosis: history and examination*, ed 6, St Louis, 2004, Mosby.)

-

Mouth: Use gloves or hold the paper-wrapped end of a partially unwrapped tongue depressor while examining the oropharynx; use a penlight (or flashlight) to illuminate the areas being inspected (Figure 4-28). Inspect the lips and mucosa for color, ulcerations, hydration, and lesions. Inspect the teeth and gums for color, bleeding, inflammation, caries, missing teeth, ulcerations, and lesions (Table 4-8). Inspect the hard palate for color, architecture, symmetry, ulcerations, and lesions. Inspect the tonsils and posterior palate for color, edema, ulcerations, exudates, and lesions. Inspect the top, sides, and bottom of the tongue for color, symmetry, ulcerations, and lesions. Note the odor of the breath (e.g., alcohol odor in alcoholic intoxication, urinous odor in uremia, sweetish fruity odor in diabetes mellitus with ketoacidosis, a musty odor [fetor hepaticus] in severe parenchymal liver disease).

Full-size image (32K)

Figure 4-28.

Oropharynx Inspection.

(From Jarvis C: *Physical examination and health assessment*, ed 5, St Louis, 2008, Saunders.)

Table 4-8. Oral Lesions

Lesion	**Description**
Aphthous ulcer (canker sore)	Painful whitish lesion with red border; usually a single lesion
Candidiasis (thrush)	Burning white curdlike lesions with peelable pseudomembranes
Hairy tongue	Painless blackened raised filiform papillae
Herpetic ulcer (cold sore; fever blister)	Painful multiple papules/vesicles; crusting as lesion heals
Leukoplakia	Painless white lesions (look like spilled paint or paint flakes); nonpeelable (precancerous)
Squamous cell carcinoma	Ulcerated single indurated lesion with clean raised borders

- **Eyes:** Inspect the external and internal structures of the eyes and, if indicated, assess visual acuity. Obtain a general assessment of visual acuity by asking the patient to read a sentence or two from any printed material (e.g., book, magazine, newspaper). The Snellen eye chart (the chart with the large E on the top line followed by a series of lines with increasingly smaller print) provides a more accurate assessment of visual acuity.

- Test the peripheral visual fields using the confrontation technique (Figure 4-29). Stand about 2 ft in front of the patient and instruct the patient to watch your face. Have the patient cover his or her left eye; cover your own eye opposite the patient's covered eye. Extend your arm beyond the patient's peripheral vision on the right and then, wiggling your fingers, move your hand in slowly until the patient can see your fingers. Have the patient cover his or her right eye and repeat from the patient's right side. With both eyes uncovered, bring your hand down from above the patient's visual field and up from below the patient's visual field. The normal visual field is ovoid (about 50 degrees upward, 90 degrees temporal, 70 degrees downward, and 60 degrees nasal) (Figure 4-30). Although it does not provide not an accurate mapping of visual fields, the confrontational visual field test is a useful general screening and monitoring tool. Diseases associated with visual field defects include optic nerve diseases such as glaucoma and retinal diseases such as retinitis pigmentosa and retinal detachment.

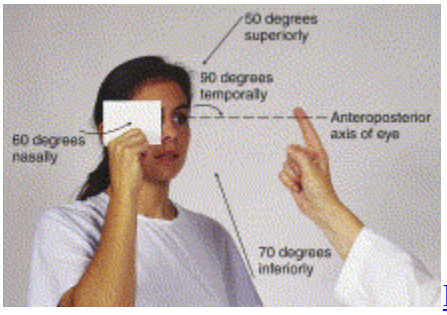
Full-size image (53K)

Figure 4-29.

Assessment of Peripheral Visual Fields by Confrontation Test.

A, Left peripheral visual fields. **B,** Right peripheral visual fields.

(From Jarvis C: *Physical examination and health assessment*, ed 5, St Louis, 2008, Saunders.)



Full-size image (30K)

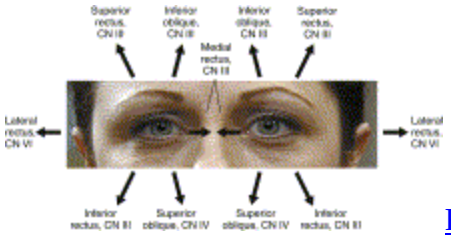
Figure 4-30.

Range of Peripheral Vision.

(From Jarvis C: *Physical examination and health assessment*, ed 5, St Louis, 2008, Saunders.)

-

Assess the extraocular muscles by having the patient follow the movements of your finger with his or her eyes (keeping the head stationary) as the finger is moved in all the six cardinal directions to test elevation, depression, adduction, abduction, extorsion, and intorsion (Figure 4-31) (Box 4-5). The eyes normally follow the finger smoothly and in parallel with the movements; however, lateral nystagmus may occur normally. Abnormalities indicate either problems with the cranial nerves that supply the eye muscles (II, IV, VI) or problems with the eye muscles themselves. Patients taking phenytoin may have far lateral nystagmus with therapeutic serum drug concentrations; vertical nystagmus may occur with phenytoin toxicity.


Superior rectus, CN III
Inferior oblique, CN III
Medial rectus, CN III
Inferior oblique, CN III
Superior rectus, CN III
Lateral rectus, CN VI
Lateral rectus, CN VI
Inferior rectus, CN III
Superior oblique, CN IV
Superior oblique, CN IV
Inferior rectus, CN III

Full-size image (42K)

Figure 4-31.

Extraocular Muscles. Associated six cardinal directions of gaze and extraocular muscles.

(From Seidel HM: *Mosby's guide to physical examination,* ed 6, St. Louis, 2006, Mosby.)

Box 4-5.

Extraocular Movements Checklist

- o □ Instruct the patient to watch your finger.
- o □ Hold your finger about 10 inches in front of the patient's face.
- o □ Test each vertical movement.
- o □ Test each lateral movement.
- o □ Test each corner-to-corner movement (upper lateral to lower medial).
- o □ Test each corner-to-corner movement (lower lateral to upper medial).
- o □ Report/record the results. (Example: The extraocular muscles are intact.)

Note the position and alignment of the eyes. If exophthalmos (abnormal protrusion of the eyeball) is observed (Figure 4-32), inspect the eye from above and note the relationship of the cornea to the eyelids. Inspect the eyelids for color, lesions, edema, and condition of the eyelashes. Inspect the conjunctiva for color and edema and the cornea and lens for opacities. Assess the corneal blink reflex by lightly touching the cornea with a tissue; the normal reflex is to blink. Exophthalmos is commonly associated with Graves' disease. Cataracts (Figure 4-33) are characterized by progressive clouding of the lens. Conjunctival injection is commonly observed in patients with seasonal and perennial

allergic rhinitis. Bimatoprost, used to treat eyelash hypotrichosis, may darken the eyelid.

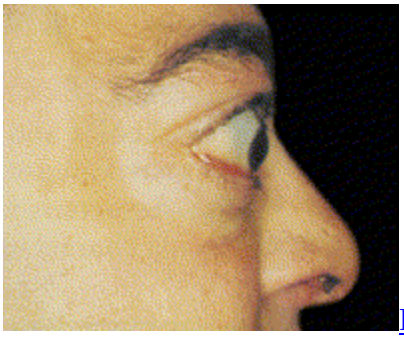
 Full-size image (13K)

Figure 4-32.

Exophthalmos.

(From Stain HA, et al: *The opthalmic assistant: fundamentals and clinical practice*, ed 6, St Louis, 1994, Mosby.)

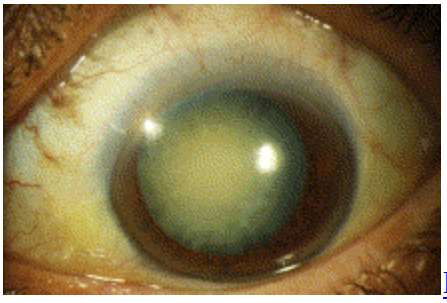
 Full-size image (20K)

Figure 4-33.

Cataract.

(From Swartz MH: *Textbook of physical diagnosis: history and examination*, ed 6, St Louis, 2004, Mosby.)

-

Inspect the iris and pupil for size, shape, and equality. Assess the iris for abnormal pigment or deposits. Ophthalmic prostaglandins (e.g., latanoprost) may darken the eyelids and increase iris pigmentation. Test the pupillary reaction to light by briefly flicking a light on the pupil and noting the direct and consensual (opposite eye) response; both pupils normally constrict in response to the light stimulus (Box 4-6). Test the pupillary reaction to accommodation by instructing the patient to focus on an object (usually your finger) from several feet away and then noting the pupillary constriction and convergence (“cross-eyed” response) of the eyes as the object is brought to within a few centimeters in front of the patient’s eyes (see Box 4-6). Drugs with anticholinergic properties (e.g., amitriptyline, imipramine, atropine) cause pupillary dilation (mydriasis). Drugs that cause pupillary constriction (miosis) include opioid narcotics (e.g., morphine)

and benzodiazepines (e.g., alprazolam). Fixed and dilated pupils indicate brainstem damage, and pupil examination is part of brain death assessment protocols.
Box 4-6.
Pupillary Response to Light and Accommodation Checklist

Pupillary Response: Left Eye

- o □ Briefly shine the light on the left eye.
- o □ Report/record the left pupillary response. (Example: The left eye pupil constricted.)
- o □ Report/record the consensual eye response. (Example: The right eye pupil constricted.)

Pupillary Response: Right Eye

- o □ Briefly shine the light on the right eye.
- o □ Report/record the right pupillary response. (Example: The right eye pupil constricted.)
- o □ Report/record the consensual eye response. (Example: The left eye pupil constricted.)

Accommodation

- o □ Hold your finger in front of the patient’s eyes from a distance of about 18 inches.
- o □ Instruct the patient to watch your finger.
- o □ Slowly move your finger in toward the patient’s nose until it almost touches the nose.
- o

□ Report/record the pupillary response. (Example: The pupils constricted.)

- Inspect the fundi with the ophthalmoscope (Box 4-7). Select the appropriate aperture (see Table 4-4) (e.g., select the smallest beam of light to assess the undilated eye). Hold the ophthalmoscope in the right hand to examine the patient's right eye and in the left hand to examine the patient's left eye. Place the index finger on the diopter wheel (Figure 4-34). Look through the ophthalmoscope with the right eye to examine the patient's right eye; use your left eye to examine the patient's left eye. Prefocus the ophthalmoscope on the wrinkle of the palm of your hand placed a few inches in front of your face; this adjusts the ophthalmoscope to your eye and saves time when focusing on the patient's eye. Place the hand not holding the ophthalmoscope on the patient's forehead; this steadies the patient's head and prevents you from bumping into the patient's forehead during the examination. If necessary, use the thumb of this hand to gently lift up the patient's eyelid. Instruct the patient to look straight ahead. Aim the beam of light at the pupil from a distance of about 15 inches and slightly lateral to the patient's line of vision (Figure 4-35). The light beam is on target when the eye appears red-orange (the red reflex); the red-orange color is the light reflecting from the retina. Move straight in toward the patient, never losing the red reflex, until your forehead nearly touches the patient's forehead (Figure 4-36). Focus by changing diopter settings (one diopter at a time) until the internal structures of the eye are in clear focus. The back of the eye is curved; any side to side, in and out, or up and down movement changes the focal distance, requiring constant refocusing.

Box 4-7.
Ophthalmoscopy Checklist

- □ Instruct the patient to stare straight ahead.
- □ Select the appropriate beam.
- □ Focus the scope on the palm of the hand before attempting to look in the patient's eye.
- □ Hold the scope correctly (right hand, right eye, right eye; left hand, left eye, left eye).
- □ Steady the patient's head by placing the nonscope hand on the patient's forehead with the thumb on the eyebrow.
-

- □ Shine the light on the patient’s eye from about 15 inches and lateral to the eye.
- □ Move in toward the patient’s eye until about 2 inches from the eye.
- □ Refocus the scope.
- □ Inspect all quadrants of the fundus.
- □ Report/record the results. (Example: Normal vessels, disc, and cup/disc ratio.)

Full-size image (26K)

Figure 4-34.

How to Hold the Ophthalmoscope.

Hold the ophthalmoscope in the right hand to inspect the right eye; hold the ophthalmoscope in the left hand to inspect the left eye.

(From Jarvis C: *Physical examination and health assessment*, ed 5, St Louis, 2008, Saunders.)

Full-size image (30K)

Figure 4-35.

Red Reflex.

Locate the red reflex.

(From Swartz MH: *Textbook of physical diagnosis: history and examination*, ed 6, St Louis, 2004, Mosby.)

Full-size image (29K)

Figure 4-36.

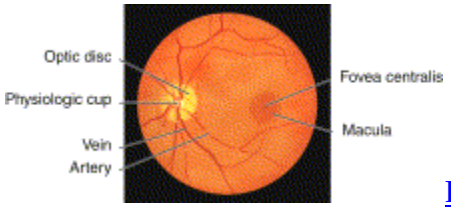
Retinal Assessment.

Examine the retina.

(From Swartz MH: *Textbook of physical diagnosis: history and examination*, ed 6, St Louis, 2004, Mosby.)

-

Inspect the retinal blood vessels, optic disc, physiologic cup, macula, and retina through the ophthalmoscope (Figure 4-37). Inspect the retina, the red-orange area on which the other structures are located, for lesions (Table 4-9). The retinal blood vessels are usually the first structures seen. The retinal arteries and veins emerge from the optic disc and have the highest density in the vicinity of the optic disc. Retinal arteries are thinner and brighter red than retinal veins. Note the size, color, and status of the arteriovenous crossings in all regions of the eyes.



Full-size image (19K)

Figure 4-37.

Retinal Anatomy.

(From Jarvis C: *Physical examination and health assessment*, ed 5, St Louis, 2008, Saunders.)

Table 4-9. Retinal Lesions

Description	**Cause**
Red, linear, or flame shaped	Bleeding in nerve fiber retinal layer
Red, round	Bleeding in deeper retinal layers

Black	Retinitis pigmentosa, melanoma, retinal degeneration
White cotton-wool appearance	Hypertension, diabetes

- The optic disc, the head of the optic nerve (also known as the *blind spot*) is a yellowish ovoid 1.5 mm in diameter with sharp margins (the margins closest to the nose may be blurred), The physiologic cup, the depressed center of the optic disc, is lighter in color than the optic disc and normally occupies about one third of the diameter of the optic disc (cup/disc ratio). Inspect the optic disc for size, shape, and sharpness of the borders and estimate the cup/disc ratio. Glaucoma is characterized by an increased cup/disc ratio (Figure 4-38).

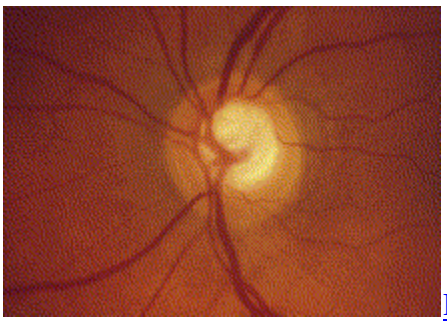

Full-size image (23K)

Figure 4-38.

Glaucomatous Cupping.

The cup/disc ratio is approximately 50%.

(From Swartz MH: *Textbook of physical diagnosis: history and examination*, ed 6, St Louis, 2004, Mosby.)

- The macula is a small, round, and extremely light-sensitive area located about two disc diameters temporally from the optic disc in an area nearly free of retinal blood vessels. The red-free filter is used to inspect the macula. The fovea is the slightly depressed area in the center of the macula.

Palpation

- **Skull:** Palpate the skull for lumps, bumps, and evidence of trauma.
- **Hair:** Palpate the hair for texture (coarse, fine, dry, oily).
-

- **Thyroid gland:** Palpate the thyroid gland for size, shape, symmetry, tenderness, and nodules.
- **Lymph nodes:** Palpate the lymph nodes (see Figure 4-25) for size, shape, mobility, and tenderness.
- **Sinuses:** Palpate the frontal, ethmoid, and maxillary sinuses for tenderness (see Figure 4-26).
- **External ear:** Palpate the external ear for nodules.

Auscultation

- **Thyroid gland:** If the thyroid gland is enlarged, auscultate the thyroid for the presence of a thyroid bruit.
- **Carotid arteries:** Auscultate the carotid arteries for carotid artery bruits.

Hearing

A commonly used but relatively inaccurate assessment of hearing is to test, one ear at a time, the ability of the patient to hear a sequence of equally accented syllables (e.g., three-five-two-four) whispered from a distance of a couple of feet. The Rinne test compares sensitivity with bone and air conduction (Figure 4-39). Place the tip of a vibrating tuning fork (128 or 512 Hz) on the mastoid process behind the ear; this tests hearing with bone conduction. Instruct the patient to signal when he or she no longer hears the vibrating tuning fork. Remove the tuning fork from the mastoid process and hold the prongs in front of but not touching the ear canal; this tests hearing with air conduction. Normally, hearing is better with air conduction than with bone conduction; that is, the patient can once again hear the vibrating tuning fork when the tuning fork is moved from the mastoid process to in front of the ear canal. To perform the Weber's test, place the tip of a vibrating tuning fork on the center of the patient's forehead (Figure 4-40). Normally, sound is heard equally well in both ears. In conduction hearing loss, the sound is heard best in the impaired ear; in unilateral sensorineural hearing loss, the sound is heard best in the unimpaired ear. Audiometry is used to establish baseline hearing and identify drug-induced hearing loss.

Full-size image (41K)
Figure 4-39.

Rinne Test.

Place the tip of the vibrating tuning fork on the mastoid process (**A**). Hold the prongs in front of the patient's ear (**B**) when the patient can no longer hear the vibrating tuning fork on the mastoid process.

(From Swartz MH: *Textbook of physical diagnosis:* history and examination, ed 6, St Louis, 2004, Mosby.)

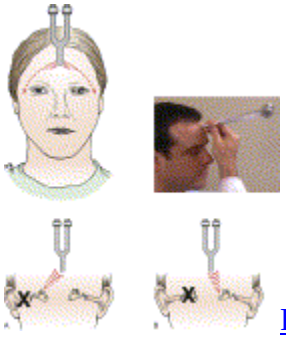

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Figure 4-40.

Weber's Test.

A, Conductive hearing loss; the vibrating tuning fork is heard best on the affected side. **B,** Sensorineural hearing loss; the vibrating tuning fork is heard best on the unaffected side.

(From Swartz MH: *Textbook of physical diagnosis: history and examination*, ed 6, St Louis, 2004, Mosby.)

Terminology

- **acromegaly:** A pituitary disorder characterized by a massive face with enlarged lower jaw, prominent nose and eyebrows, and coarse facial features and large hands and feet
-

arteriovenous (AV) nicking: An abnormality visualized on funduscopic examination and associated with hypertension; at AV crossings the vein appears to stop abruptly on either side of the arteriole

- **arteriovenous (AV) tapering:** An abnormality visualized on funduscopic examination and associated with hypertension; at AV crossings the vein appears to taper off on either side of the arteriole
- **astigmatism:** A condition characterized by unequal curvature of the cornea
- **audiometry:** A test used to determine hearing levels
- **Bell's palsy:** Unilateral paralysis of the facial nerve
- **Chvostek's sign:** Contraction or spasm of the facial muscles associated with tetany and hypocalcemia; elicited by tapping the face sharply with a finger just in front of the external auditory meatus over the facial nerve
- **conjunctival injection:** Dilated conjunctival vessels
- **copper wires:** An abnormality visualized on funduscopic examination and associated with hypertension; a coppery strip of light appears along the surface of the blood vessel
- **corneal arcus:** A thin, gray-white circle around the cornea; associated with aging
- **deep hemorrhage:** An abnormality visualized on funduscopic examination and associated with diabetes; appears as small, irregular red spots in the retina
- **exophthalmos:** Abnormal protrusion of the eyeball; associated with Graves' disease
- **fetor hepaticus:** A musty odor of the breath associated with severe parenchymal liver disease
- **fissured tongue:** Increased tongue fissures; benign; sometimes associated with aging

- **flame hemorrhage:** An abnormality visualized on funduscopic examination; associated with hypertension; appears as small, linear retinal hemorrhages
- **geographic tongue:** Denuded areas of papillae; benign
- **hairy tongue:** Elongated papillae; benign; associated with antibiotic therapy
- **hirsutism:** Increased hair growth in androgen-sensitive areas (e.g., beard or mustache areas); associated with ovarian, adrenal, thyroid, and pituitary disorders and some medications
- **hyperopia:** Farsightedness
- **Koplik's spots:** Small blue-white spots with red margins found on the mucous membranes near the parotid duct; associated with measles; appear before the skin lesions are visible
- **microaneurysm:** An abnormality visualized on funduscopic examination; associated with diabetes; appears as a tiny red spot in the macular area
- **muddy sclera:** Brownish sclera; benign; commonly found in dark-skinned individuals
- **myopia:** Nearsightedness
- **normocephalic, atraumatic:** A physical examination finding meaning that the head is of normal size and shape and no evidence of trauma is present
- **palpebral fissure:** The space between the upper and lower eyelids when the eyes are open
- **periorbital edema:** Puffiness of the upper and lower eyelids
-

Rinne test: A hearing test that compares air and bone conduction

- **smooth red tongue:** Finding associated with deficiencies of vitamin B_{12}, niacin, and iron
- **Weber's test:** A hearing test that compares bone conduction in both ears
- **xanthelasma:** Yellow, raised, well-circumscribed plaques found in the skin around the eyelids; associated with hypercholesterolemia

Chest and Lungs

Assessment of the chest and lungs requires a clear understanding of pulmonary anatomy, landmarks, and reference points (Figure 4-41). The ribs, clavicle, scapula, and vertebrae serve as useful landmarks (Figure 4-42). Count ribs on the anterior chest by placing a finger in the substernal notch and sliding the finger from the substernal notch left or right to the space between the first and second ribs; count the intercostal spaces or ribs from that point. On the posterior chest, the spinous process of the seventh cervical vertebra is quite prominent when the neck is flexed forward. The first thoracic vertebra is just below the seventh cervical vertebra; count the vertebrae from that point. Vertical reference points include the midsternal, midclavicular, anterior axillary, midaxillary, posterior axillary, scapular, and vertebral lines.

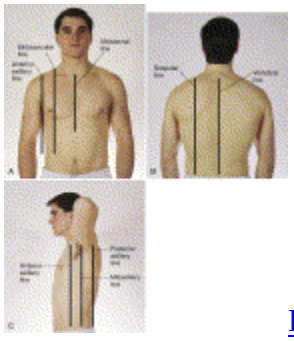

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Figure 4-41.

Thorax Topography.

A, Anterior landmarks. **B,** Posterior landmarks. **C,** Lateral landmarks.

(From Jarvis C: *Physical examination and health assessment,* ed 5, St Louis, 2008, Saunders.)

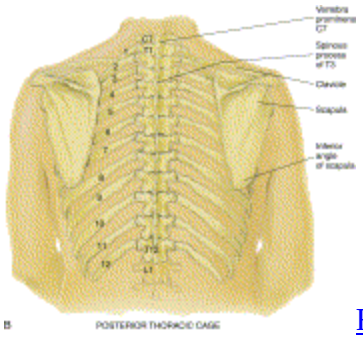

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Figure 4-42.

Thorax Topography.

A, Anterior chest skeletal landmarks. B, Posterior chest skeletal landmarks.

(From Jarvis C: *Physical examination and health assessment,* ed 5, St Louis, 2008, Saunders.)
The anterior and posterior positions of the five lobes of the lungs are each unique (Figure 4-43). On the anterior chest, the apex of the lung extends 3 to 4 cm above the medial end of the clavicles. The base of the lung extends to approximately the sixth to eighth rib. The horizontal fissure separating the right upper and middle lobes is located from the fourth rib at the midsternal line to the fifth rib at the midaxillary line. The oblique fissure separating the right middle and lower lobes is located from the fifth rib at the midaxillary line to the sixth rib at the midclavicular line. The left oblique fissure separating the left upper and lower lobes is located at a similar position on the left. On the posterior chest, the right and left oblique fissures separating the right upper and lower lobes and left upper and lower lobes, respectively, are located from approximately the third thoracic vertebra medially to the sixth rib laterally. The base of the lung extends to approximately the ninth to the twelfth thoracic vertebrae.

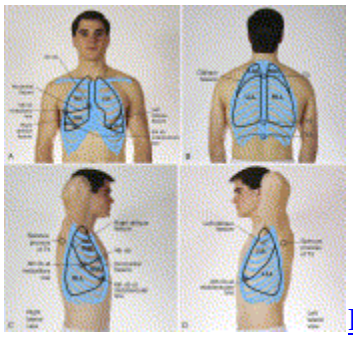
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Figure 4-43.

Anterior, Posterior, and Lateral Lobes.

A, Anterior chest. **B,** Posterior chest. **C,** Right lateral chest. **D,** Left lateral chest.

(From Jarvis C: *Physical examination and health assessment,* ed 5, St Louis, 2008, Saunders.)
Techniques

The techniques of inspection, palpation, percussion, and auscultation are used to assess the lungs. By convention, the examination is conducted from the patient's right side.

Inspection

Inspect the chest through at least one complete inspiratory-expiratory cycle. Note chest wall abnormalities, use of accessory muscles (sternocleidomastoid, abdominal), anteroposterior diameter, and skeletal abnormalities. Patients with longstanding obstructive airway disease (e.g., asthma, chronic obstructive pulmonary disease [COPD]) often have an increased anterior-posterior diameter (barrel chest) (Figure 4-44). Patients with severe acute airway obstruction often use the accessory muscles to breathe.

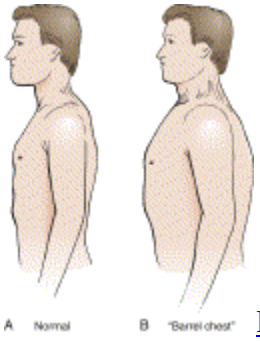

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Figure 4-44.

Chest Configurations.

A, Normal chest. **B,** Barrel chest.

(From Swartz MH: *Textbook of physical diagnosis: history and examination,* ed 6, St Louis, 2004, Mosby.)

Percussion

Percuss over the intercostal spaces (between the ribs) to assess lung density (Figure 4-45). Percussion over normal lung tissue creates a loud, low-pitched, resonant note. Percussion over areas of lung with increased air volume (e.g., emphysema) creates a very loud, low-pitched, hyperresonant note. Areas of consolidation (fluid) produce a dull or flat percussion note (e.g., lobar pneumonia); shifting dullness is associated with freely moving fluid within the pleural cavity (e.g., pleural effusion). Assess all lobes, comparing the right and left lungs.

Full-size image (23K)
Figure 4-45.

Indirect Chest Percussion.

(From Jarvis C: *Physical examination and health assessment,* ed 5, St Louis, 2008, Saunders.)
Percuss to determine diaphragmatic location and excursion (Box 4-8) (Figure 4-46). Determine the location of the diaphragm with the lungs fully expanded and with the lungs emptied. The difference between the two positions is the diaphragmatic excursion. Percuss down the posterior chest between the vertebral column and the scapula from about the sixth rib downward with the lungs fully expanded; repeat with the lungs emptied. The diaphragm is located where the percussion note changes from resonant to dull. Normal diaphragmatic excursion is about 3 to 5 cm for females and 5 to 6 cm for males; the right side of the diaphragm is slightly higher than the left side. The diaphragm is elevated when the lung on that side has collapsed (pneumothorax). The diaphragm is abnormally low with decreased excursion in chronic obstructive airway diseases associated with chronic air trapping (e.g., COPD).

Box 4-8.
Diaphragmatic Excursion Checklist

Right Side of the Diaphragm

- □ Instruct the patient to stand.
- □ Instruct the patient to inspire and hold the breath.
- □ Percuss starting midscapula.
- □ Note the location where the percussion note changes.
- □ Let the patient breathe normally for a few moments.
-

□ Instruct the patient to expire and hold the breath.

- □ Percuss starting midscapula.
- □ Note the location where the percussion note changes.
- □ Report/record the distance. (Example: Right diaphragmatic excursion is 5 cm.)

Left Side of the Diaphragm

- □ Instruct the patient to stand.
- □ Instruct the patient to inspire and hold the breath.
- □ Percuss starting midscapula.
- □ Note the location where the percussion note changes.
- □ Let the patient breathe normally for a few moments.
- □ Instruct the patient to expire and hold the breath.
- □ Percuss starting midscapula.
- □ Note the location where the percussion note changes.
- □ Report/record the distance. (Example: Left diaphragmatic excursion is 5 cm.)

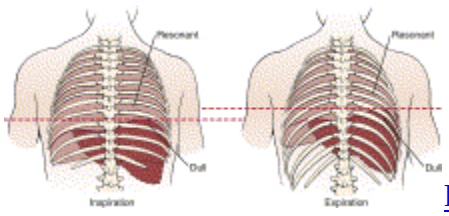

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Figure 4-46.

Diaphragmatic Excursion.

Determine the difference in the border between resonance and dullness with inspiration and expiration.

(From Swartz MH: *Textbook of physical diagnosis: history and examination,* ed 6, St Louis, 2004, Mosby.)

Palpation

Palpate the chest for masses, pulsations, crepitation, and tactile fremitus. To assess for tactile fremitus, place the palm of the hand on the chest and have the patient say “ninety-nine” or “one-two-three.” Vibrations are increased over areas of consolidation (e.g., lobar pneumonia).

The chest wall moves outward with lung expansion. Palpate for respiratory excursion by placing your hands on the patient’s anterior or posterior chest. Place the hands so that the hands cover the lower ribs with moderate pressure (thumbs touching each other, fingers spread apart) (Box 4-9). Instruct the patient to take a deep breath. With normal respiratory excursion, the hands pivot apart a few centimeters at the thumbs.

Box 4-9.
Respiratory Excursion Checklist

- □ Instruct the patient to stand.
- □ Place the palms of the hands with thumbs together and pointing up at the center of the lower rib margin.
- □ Spread the fingers apart and hold the chest with light pressure.
- □ Instruct the patient to inhale deeply.
- □ The hands should move apart slightly with the patient’s inspiration.
- □ Report/record the results. (Example: Normal respiratory excursion.)

Auscultation

Auscultate the lungs with a stethoscope (Box 4-10). On the posterior chest, auscultate between the scapulae and vertebral column (not directly over the scapulae, vertebral column, or ribs)

(Figure 4-47). Place the diaphragm of the stethoscope flat against the chest wall and instruct the patient to breathe deeply and slowly through the mouth each time the stethoscope touches the skin. Assess at least one complete respiratory cycle over each anterior and posterior lobe, comparing right and left sides; assess each lobe more thoroughly if abnormalities are detected.

Box 4-10.
Pulmonary Auscultation Checklist

Anterior

- □ Stand to the patient's right.
- □ Auscultate the right upper lobe (RUL).
- □ Auscultate the left upper lobe (LUL).
- □ Auscultate the right middle lobe (RML).
- □ Auscultate the right lower lobe (RLL).
- □ Auscultate the left lower lobe (LLL).
- □ Report/record the results. (Example: Normal breath sounds.)

Posterior

- □ Stand to the patient's right.
- □ Auscultate the RUL.
- □ Auscultate the LUL.
- □ Auscultate the RLL.
-

□ Auscultate the LLL.

-

□ Report/record the results. (Example: Normal breath sounds.)

Full-size image (22K)

Figure 4-47.

Posterior Chest Auscultation.

(From Seidel HM: *Mosby's guide to physical examination*, ed 7, St. Louis, 2011, Mosby.)
Breath sounds are described as tracheal, bronchial, bronchovesicular, or vesicular. These breath sounds are distinguishable through auscultation over areas of the lungs that normally produce the sounds (i.e., auscultation over the trachea, large central bronchi, small airways just distal to the central bronchi, and small lateral airways identifies tracheal, bronchial, bronchovesicular, and vesicular breath sounds, respectively) (Figure 4-48). These sounds are considered abnormal, however, if heard over other areas of the lungs. Other abnormal breath sounds include wheezes, rhonchi, stridor, and crackles. Abnormal breath sounds are described by location (e.g., tracheal), timing (inspiration, expiration, or both), and duration (e.g., end-expiration). Wheezes, high-pitched continuous musical sounds, are associated with airway inflammation and constriction (e.g., asthma, COPD, bronchitis, pneumonia, pulmonary edema). Rhonchi, coarse rattling sounds that change location with cough, are associated with mucus in the airways. Stridor, a high-pitched sound, is heard with upper airway constriction (e.g., croup). Crackles, intermittent crackling sounds of short duration, are associated with fluid in the alveoli and airways (e.g., bronchitis, pneumonia, heart failure, pulmonary edema). A pleural friction rub, created when the visceral and parietal pleurae rub together, sounds like creaking leather and is heard best at the base of the lung. Voice sounds are transmitted more clearly (egophony, whispered pectoriloquy) over areas of consolidation (e.g., lobar pneumonia); vocal resonance is decreased over areas of hyperinflation (e.g., COPD).

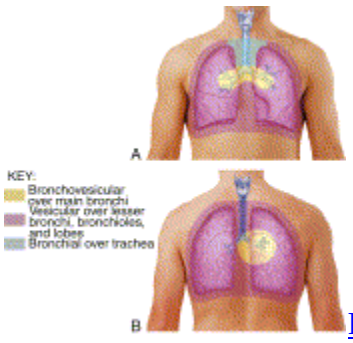

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Figure 4-48.

Locations of Expected Ausculatory Breath Sounds.

A, Anterior chest. **B,** Posterior chest.

(From Seidel HM: *Mosby's guide to physical examination*, ed 7, St. Louis, 2011, Mosby.)

Terminology

- **barrel chest:** An anterior/posterior diameter ratio of 1:1; associated with diseases characterized by chronic air trapping (e.g., COPD)
- **bronchial breath sounds:** Loud, high-pitched, normal breath sounds heard over the manubrium; normal inspiratory/expiratory ratio of 1:3
- **bronchovesicular breath sounds:** Normal breath sounds heard over the main stem bronchi just distal to the central airways; softer and lower pitched than tracheal breath sounds with equal inspiratory and expiratory duration and pitch
- **consolidation:** Increased density (e.g., fluid)
- **crackles:** Discontinuous, short-duration, bubbling sounds
- **crepitation:** Crackling
- **dullness or flatness:** Soft, medium-pitched percussion notes elicited over areas of increased density
- **egophony:** Altered vocal resonance over areas of consolidation; the spoken "e-e-e-e" is transmitted as "a-a-a-a."
- **funnel chest (pectus excavatum):** Depression of the lower part of the sternum
- **hyperresonance:** A loud, low-pitched percussion note elicited over areas of increased air volume

- **kyphoscoliosis:** Combined kyphosis and scoliosis
- **kyphosis:** Abnormal curvature of the spine with backward convexity
- **pigeon chest:** Anterior displacement of the sternum
- **pleural friction rub:** Abnormal, creaking leatherlike sound produced when the inflamed surfaces of the visceral and parietal pleurae rub against one another
- **resonance:** The loud, low-pitched percussion note elicited over normal lung tissue
- **rhonchus, rhonchi:** Coarse, rattling, abnormal breath sounds; often change location after coughing
- **scoliosis:** Abnormal lateral curvature of the spine
- **stridor:** Abnormal, high-pitched, continuous lung sounds heard over the upper airway
- **tactile fremitus:** Palpable vocal vibrations felt through the chest wall; increased over areas of consolidation; decreased over obstructed areas and pleural abnormalities
- **tracheal breath sounds:** Very loud and high-pitched harsh normal breath sounds heard over the extrathoracic trachea
- **tracheobronchial breath sounds:** Loud, high-pitched, normal breath sounds heard over large bronchi; a slight pause occurs between inspiratory and expiratory sounds; inspiratory duration is shorter than expiratory duration
- **tympany:** Loud, drumlike percussion notes elicited over hyperinflated areas
- **vesicular breath sounds:** Soft, low-pitched, normal breath sounds heard over peripheral lung tissue; inspiratory duration is longer than expiratory duration

- **wheezes:** Abnormal, high-pitched, continuous breath sounds; associated with airway obstruction
- **whispered pectoriloquy:** Transmission of whispered voice sounds more loudly and clearly than normal; associated with areas of cavitation and consolidation

Cardiovascular System

Assessment of the cardiovascular system requires a clear understanding of cardiac anatomy, landmarks, and reference points (Figure 4-49). The right ventricle occupies most of the anterior cardiac surface; the right atrium occupies a narrow border from the third to the fifth rib just right of the sternum. The other chambers of the heart are normally too posterior to be identified on examination. The left ventricular apex (apical impulse or point of maximal impulse [PMI]) is normally located at the intersection of the fifth intercostal space and the midclavicular line. The base of the heart is located between the right second intercostal space medial to the sternum and the left second intercostal space medial to the sternum.

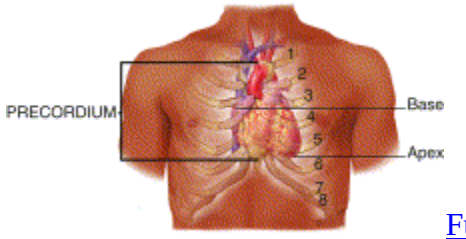

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Figure 4-49.

Cardiovascular Topography.

(From Jarvis C: *Physical examination and health assessment,* ed 5, St Louis, 2008, Saunders.)

Techniques

The techniques of inspection, palpation, and auscultation are used to assess the heart. By convention, the examination is conducted from the patient's right side. Although very light percussion may be used to determine the cardiac borders and assess for the presence of pericardial effusions, aortic aneurysm, and mediastinal tumors, percussion is not a part of the routine cardiovascular examination.

Inspection

Inspect the chest for visible cardiac motions. Estimate the jugular venous pressure (JVP) and assess the jugular venous waveforms (Figure 4-50) by observing pulsations in the jugular vein with the patient supine and the head of the bed elevated to 15 to 30 degrees. The jugular vein is located in the neck next to the point where the sternocleidomastoid muscle attaches to the clavicle. The JVP is the vertical distance between the highest point at which pulsation of the

jugular vein can be seen and the sternal angle. Because JVP depends on the angle of elevation of the head, record both the vertical distance and the angle of elevation. However, estimation of JVP by this method is highly inaccurate. More generally, the right atrial pressure is high (>15 mm Hg) if the jugular vein is distended to the jaw when the patient is seated at a 90-degree angle. The jugular venous waveforms are easiest to see in the right jugular vein, which is straighter than the left. Shine a light across the jugular vein so that up and down pulsations are visible. The a wave results from atrial contraction. The v wave results from the pressures transmitted just before the opening of the tricuspid valve. The x descent follows the a wave and represents decreased pressure as blood flows into the atrium. The y descent follows the v wave and represents decreased pressure as blood flows into the ventricle. Normally only the a and v waves are visible. Conditions associated with an elevated JVP include congestive heart failure and fluid overload.

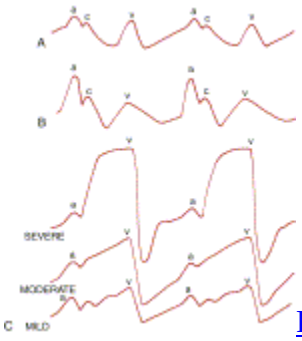

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Figure 4-50.

Jugular Venous Waveforms.

A, Normal; the a wave is produced by atrial contraction, the c wave is produced by ventricular contraction, and the v wave is produced by atrial filling. **B,** Tricuspid stenosis (giant a waves). **C,** Tricuspid regurgitation (giant v waves).

(From Price S, Wilson L: *Pathophysiology*, ed 6, St Louis, 2003, Mosby.)

Palpation

Palpate for the PMI, local and general cardiac motion, and cardiac thrills (Box 4-11). The PMI is easier to identify if the patient sits up and leans forward than if the patient is supine. The PMI normally has a diameter of about 2 cm and is located at the intersection of the fifth intercostal space and midclavicular line (within about 10 cm of the midsternal line); use the pads of the fingertips to locate the PMI. The PMI may be more central in tall, thin individuals. The PMI may be shifted downward and to the left in patients with diseases associated with an enlarged heart (e.g., congestive heart failure). Pericardial friction rubs and thrills may be palpable.

Box 4-11.
Cardiac Palpation and Auscultation Checklist

Point of Maximal Impulse (PMI)

- □ Stand to the right of the patient.
- □ Palpate for the PMI.
- □ Report/record the results. (Example: Normal PMI.)

Heart Sounds and Murmurs

Heart Sounds S_1-S_4

- □ Stand to the right of the patient.
- □ Use the stethoscope diaphragm.
- □ Auscultate the aortic area (2ICS RSB).
- □ Auscultate the pulmonic area (2ICS LSB).
- □ Auscultate the tricuspid area (LLSB).
- □ Auscultate the mitral area (5ICS MCL).
- □ Report/record the results. (Example: Normal S_1 and S_2, no S_3 or S_4.)

Murmurs

- □ Stand to the right of the patient.
- □ Use the stethoscope bell.
- □ Auscultate the aortic area (2ICS RSB).

□ Auscultate the pulmonic area (2ICS LSB).

- □ Auscultate the tricuspid area (LLSB).
- □ Auscultate the mitral area (5ICS MCL).
- □ Report/record the results. (Example: No murmurs.)

2ICS, Second intercostal space; *5ICS*, fifth intercostal space; *LSB*, left sternal border; *LLSB*, left lower sternal border; *MCL*, midclavicular line; *RSB*, right sternal border.

Palpate for the radial, carotid, brachial, femoral, popliteal, posterior tibial, and dorsalis pedis peripheral pulses (Figure 4-51). Rate the strength of the pulse as normal, diminished, or absent; a rating scale may be used. The typical rating scale ranges from 0 to 4+, with 2+ denoting a normal-strength pulse (Table 4-10). All the peripheral pulses are diminished or absent when the patient is in shock. The popliteal, posterior tibial, and dorsalis pedis pulses are reduced in patients with peripheral arterial disease. The peripheral pulses may be stronger than normal during exercise.

Full-size image (84K)

Figure 4-51.

Arterial Pulse Palpation.

A, Carotid. **B,** Brachial. **C,** Radial. **D,** Femoral. **E,** Popliteal. **F,** Dorsalis pedis. **G,** Posterior tibial.

(From Seidel HM: *Mosby's guide to physical examination*, ed 7, St. Louis, 2011, Mosby.)

Table 4-10. Peripheral Vascular Pulse Rating Scale

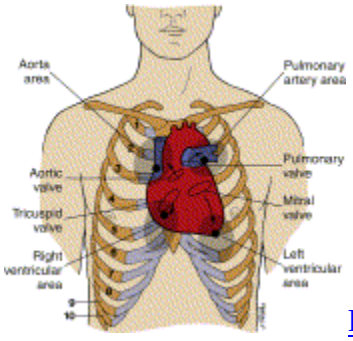
Rating	Meaning
0	No pulse palpable
1+	Markedly impaired pulse
2+	Normal pulse
3+	Increased pulse

Rating	Meaning
4+	Bounding (markedly increased) pulse

Auscultation

Auscultate the heart with a stethoscope (see Box 4-11). Use the diaphragm to assess higher-pitched sounds (e.g., S_1, S_2, S_3, S_4); apply the diaphragm tightly to the skin. Use the bell to assess lower-pitched sounds (e.g., murmurs); apply the bell loosely to the skin. A great deal of practice and experience are required to identify and distinguish among the variety of normal and abnormal heart sounds. Heart sounds are very soft; it may help to listen in a quiet area or to close the eyes to reduce conflicting stimuli.

The auscultatory areas (Figure 4-52) are close to, but not the same as, the anatomic locations of the valves. The aortic auscultatory area is located over the second intercostal space at the right sternal border; the pulmonic auscultatory area is located over the second intercostal space at the left sternal border; the tricuspid auscultatory area is located over the left lower sternal border; and the mitral auscultatory area is located at the cardiac apex (fifth intercostal space midclavicular line). These auscultatory areas shift according to the size and location of the heart, so it is important to start the auscultatory process over these locations but then to search for the loudest heart sounds by systematically shifting the position of the stethoscope.



Full-size image (49K)

Figure 4-52.

Cardiovascular Auscultatory Areas.

The first heart sound (S_1), created by mitral and tricuspid valve closure, is loudest at the cardiac apex. The second heart sound (S_2), created by aortic and pulmonic valve closure, is loudest at the base of the heart. The second heart sound can be split into distinct aortic and pulmonic components by deep inspiration (physiologic splitting) or disease (e.g., pulmonary hypertension). The third heart sound (S_3), an abnormal heart sound associated with volume overload, is a soft sound heard just after S_2. The fourth heart sound (S_4), an abnormal heart sound associated with pressure overload, is a soft sound heard just before S_1. S_1 and S_2 are assessed in all four auscultatory areas with the patient in the upright and supine positions. Note the relationship of breathing to the intensity of the cardiac sounds. Palpate the carotid artery to help determine the timing of cardiac events and sounds (the S_1 precedes and the S_2 follows the carotid pulse).

Other abnormal heart sounds include opening snaps (associated with mitral stenosis), ejection clicks (associated with sudden dilation of the aorta and the pulmonary artery), and midsystolic clicks (associated with floppy mitral valves). Gallops are exaggerated normal diastolic sounds; friction rubs are associated with pericarditis. Some heart sounds are heard best if the patient is in a specific body position. For example, aortic sounds and pericardial friction rubs are heard best when the patient sits up and leans forward. S_3, S_4, and aortic insufficiency and mitral stenosis murmurs are heard best when the patient is supine and turned to the left.

Murmurs (abnormal heart sounds caused by turbulent flow across a valve or the septum and by diseases such as anemia and hyperthyroidism) are described according to their timing in the cardiac cycle (systolic murmurs occur between S_1 and S_2; diastolic murmurs occur between S_2 and S_1), loudest location, radiation, shape (crescendo, decrescendo, crescendo-decrescendo, continuous), duration (continuous; early, mid, late systolic; diastolic; holosystolic or pansystolic), intensity (grade I through VI) (Table 4-11), and pitch or quality of sound (low, medium, high). A palpable murmur is known as a *thrill.*

Table 4-11. Murmur Rating Scale

Grade	Meaning
I	Very faint
II	Soft
III	Moderately loud
IV	Loud
V	Very loud; may be heard with the stethoscope partially off the chest wall
VI	Very loud; can be heard with the stethoscope off the chest wall

Auscultation also is used to detect vascular murmurs, known as *bruits* (pronounced “brew-ee”). Bruits (sounds made by turbulent blood flow) are heard over vessels with constricted lumens (e.g., over vessels partially occluded with plaque). The carotid and femoral arteries are routinely assessed for bruits; bruits are sometimes found over the vertebral, subclavian, and abdominal arteries.

Terminology

- **bradycardia:** A slow (<60 beats/min) heart rate
- **bruit:** An abnormal auscultatory sound heard over a blood vessel; associated with turbulent blood flow
- **crescendo-decrescendo murmur:** A murmur that increases and then decreases in intensity

- **diastolic murmur:** A murmur heard during diastole
- **ejection clicks:** Abnormal heart sounds caused by dilation of the aortic and pulmonary arteries
- **gallop rhythm:** Exaggerated diastolic heart sounds
- **holosystolic murmur:** A murmur heard throughout systole
- **hypertension:** Elevated blood pressure
- **hypotension:** Low blood pressure
- **midsystolic clicks:** Abnormal heart sounds caused by floppy mitral valves
- **opening snap:** An abnormal diastolic heart sound caused by the opening of a stenotic mitral valve
- **orthostatic hypotension:** A fall in SBP of 15 mm Hg or more when the patient assumes a more upright position
- **pansystolic murmur:** A murmur heard throughout systole
- **pericardial friction rub:** An abnormal sound created when the visceral and parietal pericardial membranes rub against one another
- **point of maximal impulse (PMI):** Right ventricular thrust (apical impulse)
- **pulsus alternans:** Regular alteration of strong and weak pulse beats; associated with heart failure
- **pulsus paradoxus:** Decreased SBP with inspiration; normally the decrease is about 5 mm Hg

- **regurgitant murmur:** A murmur produced by backflow of blood across an incompetent valve
- **S_1:** The first heart sound; produced by mitral and tricuspid valve closure
- **S_2:** The second heart sound; produced by aortic and pulmonic valve closure
- **S_3:** The third heart sound; produced by the sudden distention of the ventricular wall during ventricular filling; associated with heart failure
- **S_4:** The fourth heart sound; produced by increased left ventricular end-diastolic pressure and loss of ventricular distensibility; associated with hypertension
- **Split S_2:** Finding in which the two components of the second heart sound (aortic and pulmonic) are distinguishable; may result from deep inspiration and any disease that delays the closure of the pulmonic valve
- **stenosal murmur:** A murmur caused by increased flow across a normal valve, valvular or subvalvular stenosis, or other deformity of the valve
- **systolic murmur:** A murmur heard during systole
- **tachycardia:** A rapid (>100 beats/min) heart rate
- **thrill:** Palpable vibrations produced by turbulent blood flow

Breasts and Axillae

Techniques

Inspect and palpate the breasts and axillae.

Inspection

Inspect the breasts with the patient in sitting and supine positions. Inspect for size, symmetry, contour, and appearance of the skin. Abnormal findings on inspection include visible masses, dimpling, localized flattening, rashes, ulcers, and discharge from the nipple.

Palpation

Palpate the breasts for nodules, indurations, and areas of tenderness or increased warmth. The axillary lymph nodes, including the pectoral, subscapular, and lateral groups, are located high in the axilla close to the ribs. Palpate the nodes for size, consistency, and tenderness.

Terminology

- **gynecomastia:** Hypertrophy of breast tissue; associated with liver cirrhosis, Addison's disease, Klinefelter's syndrome, and some medications (e.g., spironolactone)
- **mastodynia:** Painful breasts
- **peau d'orange:** Breast skin with an orange-peel appearance (prominent pores); indicates lymphatic obstruction and is an important sign of malignancy
- **retraction:** Dimpling of the skin, nipple retraction or inversion

Abdomen

Techniques

The abdomen is evaluated through inspection, percussion, palpation, and auscultation (Box 4-12). Auscultation must be performed immediately after inspection to avoid acute examination-related changes in abdominal sounds. The examination is conducted at the patient's right side with the patient lying supine. Instruct the patient to bend the knees and place the feet flat on the examining table if the abdomen is tense. To decrease the sensitivity of ticklish patients, have the patient place his or her hand over your hand.

Box 4-12.
Abdominal Checklist

Bowel Sounds

- □ Instruct the patient to assume a supine position.
-

□ Stand to the right of the patient.

- □ Place the diaphragm of the stethoscope just above and to the right or left of the umbilicus.
- □ Auscultate for at least 2 minutes.
- □ Report/record rate. (Example: Three bowel sounds per minute.)

Liver Span

- □ Instruct the patient to assume a supine position.
- □ Stand to the right of the patient.
- □ Percuss (indirectly or directly) down the right midclavicular line.
- □ Start percussing several inches above the right rib margin.
- □ Stop percussing several inches below the right rib margin.
- □ Report/record the liver span. (Example: The liver span is 10 cm.)

Liver Edge

- □ Instruct the patient to assume a supine position.
- □ Stand to the right of the patient.
- □ Place the palm of the hand (fingers towards the patient's head) on the right side of the patient's abdomen.
- □ Position the hand so that the fingertips are a few inches below the right rib margin in

the midclavicular line.

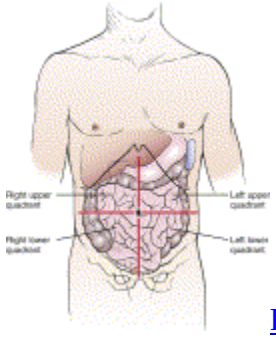
- □ Place the other hand on top of first hand.
- □ Instruct the patient to take a deep breath in and hold it.
- □ Push down and upward as the patient inspires.
- □ Report/record the characteristics of the liver edge. (Example: The liver edge is firm and smooth.)

Assessment of the abdomen requires a clear understanding of abdominal anatomy (Table 4-12), landmarks, and reference points. The abdominal area is divided into four quadrants (right upper, right lower, left upper, left lower) by imaginary vertical and horizontal lines that cross at the umbilicus (Figure 4-53); report findings by quadrant (e.g., right upper quadrant tenderness).

Table 4-12. Abdominal Anatomy

Quadrant	**Structures**
Right upper quadrant	Liver, gallbladder, portion of ascending colon, portion of transverse colon, pylorus, duodenum,* head of pancreas,* right adrenal gland,* upper pole of right kidney*
Right lower quadrant	Appendix, cecum, portion of ascending colon, right ureter, lower pole of right kidney,* bladder (if enlarged), right ovary, right fallopian tube, uterus (if enlarged), right spermatic cord
Left upper quadrant	Liver, spleen, stomach, body of pancreas,* portion of transverse colon, portion of descending colon, left adrenal gland*
Left lower quadrant	Sigmoid colon, portion of descending colon, lower pole of left kidney,* left ureter, bladder (if enlarged), left ovary, left fallopian tube, uterus (if enlarged), left spermatic cord

* Normally too deep to be palpable.



Full-size image (45K)

Figure 4-53.

Abdominal Quadrants.

The four abdominal quadrants.

(From Swartz MH: *Textbook of physical diagnosis: history and examination,* ed 6, St Louis, 2004, Mosby.)

Inspection

Inspect the abdomen for the appearance of the skin, umbilicus, and abdominal contour (scaphoid, protuberant); note visible aortic and hepatic pulsations, peristaltic waves, and fluid shifts. Free fluid in the peritoneal cavity (ascites) may shift with position, causing bulging at the flanks when the patient is supine.

Auscultation

Auscultate the abdomen for bowel sounds and abdominal bruits (Figure 4-54). Bowel sounds, produced by the movement of fluid and air in the bowel, vary from low rumbles in loosely stretched intestines to high-pitched tinkling sounds in tightly stretched intestines; bowel sounds audible without a stethoscope are called *borborygmi.* Normal peristaltic movement creates normal bowel sounds; bowel sounds are absent if there is no peristalsis. Auscultate for 2 minutes if normal bowel sounds are present (normal bowel sounds occur approximately every 10 seconds) and for 3 minutes if bowel sounds are absent. Listen in one quadrant to screen for bowel sounds. Depending on the clinical situation, it may be necessary to listen for bowel sounds in all four quadrants. Diarrhea often is associated with increased bowel sounds. Constipating diseases (e.g., irritable bowel syndrome, hypothyroidism, spinal cord injuries) and drugs (opiates, first-generation antihistamines, phenothiazines, tricyclic antidepressants, antacids containing calcium carbonate or aluminum hydroxide, iron, nonsteroidal antiinflammatory drugs) cause decreased bowel sounds. Listen for bruits over the aorta, right and left renal arteries, right and left iliac arteries, and right and left femoral arteries; friction rubs may be heard over the liver and spleen.

Full-size image (28K)

Figure 4-54.

Abdominal Auscultation.

(From Swartz MH: *Textbook of physical diagnosis: history and examination,* ed 6, St Louis, 2004, Mosby.)

Percussion

Percuss to determine the liver span and to differentiate between abdominal fluid and air. Percussion over the liver produces a dull note; percussion over air-filled loops of bowel produces a hollow tympanic note. Determine the liver span by percussion down the right midclavicular line starting at midchest (Figure 4-55). The normal liver span along the right midclavicular line is about 10 cm. The liver span is evident as the percussion note changes from the initially resonant lung note to a dull liver note and then to a tympanic colonic note. Hepatitis is a common cause of an enlarged liver. Cirrhosis is a common cause of a smaller than normal liver.

Full-size image (67K)
Figure 4-55.

Liver Span.

A, Percussion route. **B,** Percussion technique. **C,** Liver span.

(From Wilson SF, Giddens JF: *Health assessment for nursing practice,* ed 4, St Louis, 2009, Mosby.)
Percuss each quadrant. In diseases associated with ascites (e.g., end-stage liver disease), shifting dullness indicates freely moving fluid. In the supine position, air-filled loops of bowel float to the surface of the abdomen and may obscure abdominal fluid. In these cases a puddle sign is elicited by having the patient lie prone on the abdomen for a few moments and then shift to a hands-and-knees position. The fluid collects, or puddles, over the gravity-dependent portion of the abdomen and can be identified with percussion.

Palpation

Palpate tender or rigid areas with light palpation; use the pads of the fingertips with light pressure (as if kneading bread dough). Use deep palpation (significant downward pressure) to determine the outlines of the abdominal organs and to assess the size, shape, mobility, and tenderness of the lymph nodes (Figure 4-56). Palpate all four quadrants.

Full-size image (18K)
Figure 4-56.

Liver Palpation.

(From Swartz MH: *Textbook of physical diagnosis: history and examination,* ed 6, St Louis, 2004, Mosby.)
Palpate for the liver edge using deep palpation just below the right costal margin during full inspiration. Place the left hand under the back on the posterior twelfth rib along the iliac crest. Place the right hand in the right upper quadrant parallel and lateral to the rectus muscle and a couple of inches below the lower margin of dullness as identified on percussion. Instruct the patient to take a deep breath and hold the breath. Lift the left hand upward and push the right hand inward and upward as the patient inspires. The liver edge, normally smooth, firm, and regular, slides over the fingertips as the liver is pushed downward by the expanding lungs. Cirrhosis is associated with a very firm liver edge. Liver cancer causes a nodular liver edge.

The kidneys may be palpated on deep palpation, but the normal-sized spleen, duodenum, and pancreas cannot be palpated. The tip of an enlarged spleen may be palpated near the left tenth rib just posterior to the midaxillary line. Intraabdominal structures may not be palpable if the abdomen is obese or distended by fluid. Abdominal rigidity (tensing of the abdominal muscles) maybe present if the abdomen is tender. Rebound tenderness (tenderness when deep pressure is released) may be elicited if the parietal peritoneum is inflamed.

A fluid wave may be elicited in patents with abdominal ascites (Figure 4-57). Press the ulnar surface of one hand midline against the surface of the abdomen to dampen the transmission of the wave through the fat layer. Then generate a fluid wave by sharply tapping the lateral wall of the abdomen with the other hand. The fluid wave is transmitted to the other side of the abdomen and felt by the hand placed on the opposite lateral abdominal wall.

Full-size image (40K)

Figure 4-57.

Fluid Wave.

(From Swartz MH: *Textbook of physical diagnosis: history and examination,* ed 6, St Louis, 2004, Mosby.)

Terminology

- **ascites:** Free fluid in the peritoneal cavity
- **borborygmi:** Very loud gurgling and tinkling bowel sounds audible without a stethoscope; associated with hyperperistalsis
- **caput medusae:** Dilated veins radiating from the umbilicus; associated with portal vein obstruction
- **costal margin:** The edge of the lower rib cage
- **costovertebral angle:** The angle formed by the intersection of the bottom of the rib cage and the vertebral column
- **epigastric region:** The upper central abdominal area
- **fluid wave:** A wave associated with free fluid in the abdominal cavity
- **hypogastric region:** The lower central abdominal area
- **peristalsis:** The circular intestinal contractions that propel the intestinal contents forward
- **puddle sign:** Gravity-dependent pooling of fluid at the surface of the abdomen
- **rebound tenderness:** Pain elicited when abdominal hand pressure is abruptly removed; associated with parietal peritoneal membrane inflammation

Rovsing's sign: Right lower quadrant pain elicited by left-sided abdominal pressure; associated with appendicitis

- **scaphoid:** Concave appearing
- **shifting dullness:** Dull percussion notes that shift as the patient shifts position; associated with free fluid in the abdominal cavity
- **spider telangiectasia (spider angioma):** Dilated small surface arteries that appear as small red spots with multiple radiating arms; associated with portal hypertension
- **striae:** Discolored stripes of skin that result from ruptured elastic fibers; striae are pinkish or bluish when relatively new and more whitish when older
- **suprapubic region:** The abdominal area just above the pubic arch
- **umbilical region:** The area around the umbilicus

Genitourinary System

Techniques

The genitourinary system is evaluated using inspection and palpation.

Inspection

Inspect sacrococcygeal and perianal areas for lumps, ulcerations, rashes, swelling, external hemorrhoids, and excoriations. Inspect the female external genitalia (mons pubis, labia, perineum, labia minora, clitoris, urethral orifice, and introitus) for abnormalities, including lumps, ulcerations, rashes, swelling, excoriations, and discharge. Inspect the male external genitalia (penis and scrotum) for contour and abnormalities, including lumps, ulcerations, inflammation, excoriations, and swelling.

The female pelvic examination consists of an inspection and palpation (see later discussion). Inspect the vaginal wall and cervix for color, lesions, and the shape of the cervix and cervical os. Note the position of the cervix. Cervical cells may be collected for cytologic evaluation (Papanicolaou [Pap] test).

Palpation

Palpate the anus and rectal wall for tone and tenderness. The prostate is palpated for size, consistency, and tenderness. Palpate the penis for indurations or other abnormalities and palpate the scrotal structures (testis and epididymis) for size, shape, consistency, and tenderness. Palpate the inguinal and femoral areas for bulges that may indicate hernias.

Palpate the uterus and ovaries for size, shape, consistency, masses, tenderness, and mobility. The bimanual examination is performed by palpating the internal structures between a hand placed on the abdominal wall and a finger placed in the vagina. The combined rectovaginal examination is performed by palpating the adnexa, cul-de-sac, and uterosacral ligaments between a finger placed in the vagina and a finger placed in the rectum.

Terminology

- **angiokeratoma:** Red, slightly raised, pinpoint benign scrotal lesions; common after age 50 years
- **anteverted, anteflexed uterus:** Normal uterine position
- **chancre:** A hard infectious venereal ulcer
- **chancroid:** A soft infectious venereal ulcer
- **condylomata acuminata:** Venereal warts
- **gravid:** Pregnant
- **hernia:** Protrusion of an organ through the muscular wall that normally contains the organ
- **hydrocele:** Serous fluid–containing cavity
- **Papanicolaou (Pap) test:** Screening technique for cervical carcinoma
- **prostatic hypertrophy:** Enlarged prostate

varicocele: Enlarged spermatic cord

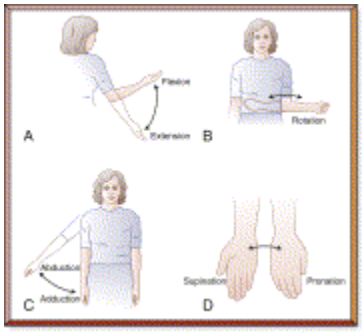
Musculoskeletal System

Techniques

The musculoskeletal system is evaluated primarily through inspection and palpation.

Inspection

Inspect the musculoskeletal system for symmetry, proportion, and muscular development; note the curvature of the spine. Observe the gait; stance; ability to stand, sit, and rise from a sitting position; and ability to grasp objects. Inspect the muscles for symmetry and movement (Figure 4-58). Patients with osteoarthritis may have enlarged distorted joints (Figure 4-59). Patients with rheumatoid arthritis may have ulnar deviation (Figure 4-60). Muscle mass is lost with disuse; the limbs of paralyzed patients may have very little muscle mass.



Full-size image (30K)

Figure 4-58.

Muscle Movements.

A, Flexion and extension. **B,** Rotation. **C,** Abduction and adduction. **D,** Supination and pronation.

(From Gerdin J: *Health careers today,* ed 4, St Louis, 2007, Mosby.)

Full-size image (32K)

Figure 4-59.

Osteoarthritis.

(From Swartz MH: *Textbook of physical diagnosis: history and examination,* ed 6, St Louis, 2004, Mosby.)

Full-size image (42K)

Figure 4-60.

Rheumatoid Arthritis.

(From Swartz MH: *Textbook of physical diagnosis: history and examination,* ed 6, St Louis, 2004, Mosby.)

Palpation

Palpate the large and small joints. Assess joint range of motion. Decreased range of motion is associated with arthritis, fibrosis in or around the joint, tissue inflammation around the joint, and fixed (immobile) joints. Increased range of motion indicates increased joint mobility and may be a sign of joint instability. Limits or extension of the range of motion of a joint are reported in degrees. Assess joint tenderness by gently palpating in and around the joint. Assess the areas in and around the joints for abnormalities such as warmth, tenderness, crepitation, and deformities.

Terminology

- **activities of daily living (ADLs):** Routine activities such as getting dressed, cleaning the teeth, combing or brushing the hair, bathing, and feeding oneself
- **boutonnière deformity:** Flexion of the proximal interphalangeal joint with hyperextension of the distal interphalangeal joint
- **crepitation:** Audible or palpable crackling sounds
- **dorsiflexion:** Inward flexion
- **eversion:** The turning of the toes onto the great toe (bottom of the foot turned outward)

- **extension:** The bending of a joint to bring the joint parallel to the long axis
- **flexion:** The bending of a joint to bring the parts of the joint into close approximation
- **gait:** The way a person walks
- **inversion:** The turning of the toes onto the small toes (bottom of the foot turned inward)
- **kyphosis:** Convex backward spinal curvature
- **list:** Lateral deviation of the spine
- **lordosis:** Anteroposterior curvature of the spine (i.e., an accentuation of the normal lumbar curve)
- **neutral range of motion:** Zero degrees
- **plantar flexion:** Downward flexion of the foot
- **radial deviation:** Deviation of the fingers toward the radial bone
- **rheumatoid nodules:** Firm, nontender, unattached subcutaneous nodules at pressure points (e.g., elbow, back of forearm) associated with rheumatoid arthritis
- **scoliosis:** Lateral curvature of the spine
- **station:** The way a person stands
- **ulnar deviation:** Deviation of the fingers toward the ulnar bone

Neurologic System

The neurologic examination assesses mental status, cranial nerve function, sensory and motor function, cerebellar function, and reflexes. Test each component separately; the standard IPPA

approach is not used. A complete neurologic assessment is complex and time consuming; however, unless neurologic abnormalities are suspected or detected, the neurologic examination is limited to a simple screening examination of mental status, major reflexes, and major motor function.

Mental Status

The standard mental status examination assesses the 12 components described below. The Mini-Mental State Examination (MMSE), an abbreviated mental status examination, assesses orientation, speech and vocabulary, memory, calculation, and construction praxis. A simple screening examination may consist of a quick assessment of short-term memory, orientation, and abstract thinking (Box 4-13).

- **Affect:** Determine whether the patient's affect (emotion or mood) is appropriate to the situation.
- **Abstract thinking:** Ask the patient to interpret a common proverb, such as "A bird in the hand is worth two in the bush" or "The grass is always greener on the other side of the fence." Alternatively, ask the patient to explain how items are similar or dissimilar (e.g., "What do bananas, apples, and oranges have in common?" or "What is the difference between a book and a videotape?").
- **Alertness:** Determine the patient's level of consciousness (awake, alert, confused, unresponsive).
- **Calculation:** Ask the patient to perform serial seven subtractions, starting from 100 (i.e., 100 minus 7 is 93, 93 minus 7 is 86, 86 minus 7 is 79, etc.). Alternatively, ask the patient to spell the word *world* backward.
- **Current Events:** Ask the patient to name the current mayor, governor, or president or ask the patient about a general current event (e.g., major sports game, natural disaster, etc.).
- **Judgment:** Ask the patient to interpret a simple problem that involves judgment, such as, "What would you do if you noticed a stamped, addressed envelope on the sidewalk near a mailbox?"
- **Memory (immediate, short-term, and long-term memory):** To assess immediate

memory, say a list of single-digit numbers and have the patient immediately repeat the list. To assess short-term memory, have the patient memorize three unrelated words (e.g., cat, bus, pencil). Ask the patient to repeat the words to ensure that the patient knows the words; then ask the patient to repeat the three words a few minutes later. To assess long-term memory, ask the patient about an age-appropriate, well-known historical event (e.g., D-Day, the assassination of President Kennedy, the September 11, 2001, twin tower attacks).

- **Object recognition:** Ask the patient to identify several well-known objects (e.g., watch, belt, ring, coin).
- **Orientation:** Determine the patient's orientation to person, place, and time. Ask, "What is your name?" "Where are you?" and "What is today's date?" (or day, month, year, or season, depending on the patient's circumstances).
- **Praxis:** Ask the patient to perform a multistep motor activity (e.g., "Pick up a piece of paper with your left hand, crumple it, and hand it to me").
- **Speech:** Have the patient say, "No ifs, ands, or buts."
- **Vocabulary:** Note the patient's vocabulary throughout the interview. Ask the patient to define a series of increasingly difficult words.

CRANIAL NERVES

Box 4-13.
Mental Status Checklist

Short-Term Memory

- □ Give the patient three words to remember.
- □ Ask the patient to repeat the three words.
- □ Repeat the three words for the patient and remind the patient to remember the words.

□ A few minutes later, ask the patient to recall the three words.

- □ Report/record the results. (Example: Normal short-term memory.)

Orientation

- □ Ask the patient, “What is your name?”
- □ Ask the patient, “What place is this?”
- □ Ask the patient, “What day is it?”
- □ Report/record the results. (Example: Oriented to person, place, and time.)

Abstract Thinking

- □ Ask the patient to interpret a common proverb (or give the patient a list of related items and ask the patient how the items are similar).
- □ Report/record the results. (Example: Normal abstract thinking.)

Each of the 12 cranial nerves (Table 4-13) is assessed individually.

- **I—Olfactory nerve:** Evaluate the olfactory nerve only if the patient complains of loss of the sense of smell or the patient has a head injury. Ask the patient to close his or her eyes and identify (one nostril at a time) a familiar odor (e.g., soap, coffee, toothpaste).
- **II—Optic nerve:** Test the patient’s visual fields (refer to page 59) and ability to discriminate between colors.
- **III, IV, and VI—Oculomotor, trochlear, and abducens nerves:** Evaluate the oculomotor, trochlear, and abducens nerves (known collectively as the *ocular nerves*) as a group. Observe the size and shape of the pupils, pupillary reaction to light and accommodation, and extraocular movements (refer to page 62).

V—Trigeminal nerve: Ask the patient to clench the teeth. Test the patient's ability to sense stimuli (sharp, dull, hot, and cold) over the front half of the head.

- **VII—Facial nerve:** To assess motor function, observe facial movements when the patient frowns, smiles, puffs out the cheeks, whistles, and raises the eyebrows. To assess sensory function, test the patient's ability to identify sweet, sour, and salty solutions placed on the sides of the tongue.
- **VIII—Acoustic nerve:** Test hearing (see pages 63-64) and balance.
- **IX and X—Glossopharyngeal and vagus nerves:** Assess quality of speech and the gag reflex. Observe the movement of the soft palate and uvula as the patient says "ahh."
- **XI—Accessory nerve:** Test the patient's ability to shrug his or her shoulders and turn the chin from side to side against resistance.
- **XII—Hypoglossal nerve:** Ask the patient to stick out his or her tongue. Note abnormalities such as fasciculations, asymmetry, deviations, or atrophy.

Table 4-13. Cranial Nerves

Cranial Nerve	**Function**
I—Olfactory	Sense of smell
II—Optic	Vision
III—Oculomotor	Pupillary constriction; upper eyelid elevation; most extraocular movement
IV—Trochlear	Downward and inward eye movements
V—Trigeminal	Motor function of temporal and masseter muscles; lateral movement of the jaw
VI—Abducens	Lateral deviation of the eyes
VII—Facial	Facial muscle movements; sense of taste on anterior two thirds of the tongue
VIII—Acoustic	Hearing and balance
IX—Glossopharyngeal	Sensation of the posterior portion of the eardrum, ear canal, pharynx, and posterior tongue, including taste, motor activity of the pharynx
X—Vagus	Sensation of the pharynx and larynx; motor function of the palate, pharynx, and larynx
XI—Accessory	Motor function of the sternomastoid and upper portion of the trapezius muscle
XII—Hypoglossal	Motor activity of the tongue

Sensory and Motor Function

Assess sensory function by testing the patient's ability to detect a variety of sensory stimuli. Ask the patient to close his or her eyes. Start distally and work proximally, comparing left and right sides. Ask the patient to identify when and where he or she is touched. Employ a variety of stimuli, including light touch (use a wisp of gauze or tissue), pain (use a sharp object such as the broken end of a sterile tongue depressor), and vibration (place a vibrating tuning fork over a bony prominence). A thorough examination tests all major peripheral nerves and dermatomes (Figure 4-61). Assess tactile localization, proprioception, graphesthesia (Box 4-14), and point localization.

Full-size image (143K)

Figure 4-61.

Dermatomes.

Segmental spinal nerve distribution. **A,** Anterior. **B,** Posterior.

(From Swartz MH: *Textbook of physical diagnosis: history and examination,* ed 6, St Louis, 2004, Mosby.)

Box 4-14.

Cerebellar and Sensory Function Checklist

Cerebellar Function

- □ Instruct the patient to hold his or her hand a full arm's length in front of the patient.
- □ Hold your finger in front of the patient's outstretched hand.
- □ Instruct the patient to touch his or her nose and then your finger alternately and rapidly.
- □ Report the results. (Example: Normal cerebellar function.)

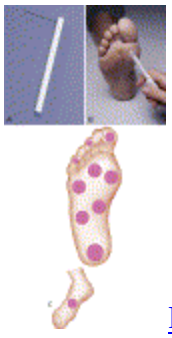
Sensory Function (Graphesthesia)

- □ Instruct the patient to close his or her eyes.
- □ Trace a number or letter on the patient's palm (orient the number or letter so that it is up in relation to the patient).
- □ Ask the patient to identify the number or letter.
- □ Report/record the results. (Example: Normal graphesthesia.)

Monofilament Foot Examination

- □ Inspect each foot for ulcers and/or lesions.
- □ Direct the patient to close his or her eyes and to tell you when the monofilament is felt.
- □ Apply the appropriate pressure to each area of each foot (see figure 4-62c).
- □ Report/record the results. (Example: Normal sensation.)

The monofilament test (Figure 4-62; see Box 4-14) is commonly used to assess sensory function in the feet of diabetic patients and in patients receiving neurotoxic drugs such as vincristine. With the patient seated, inspect the feet for lesions or ulcers. Then direct the patient to close his or her eyes and to say yes when the patient feels the monofilament. Test the pads of the first and fourth toes and several locations on the plantar surface of the foot. Touch the skin with the tip of a 10-g monofilament and apply enough pressure to bend the monofilament; touch the patient for about 1.5 seconds at each spot.



Full-size image (39K)

Figure 4-62.

Monofilament Test.

A, Monofilament. **B,** Press hard enough to bend the filament. **C,** Testing sites.

(From Seidel HM: *Mosby's guide to physical examination*, ed 7, St. Louis, 2011, Mosby.)
Observe the patient for abnormal involuntary muscle movements, resting muscle tone, and strength against resistance. Muscle strength is evaluated using a plus scale, with 0 representing no muscle contraction (complete paralysis) and 5+ representing normal muscle strength (Table 4-14). Evaluate motor function by assessing muscle tone during passive flexion and extension (increased resistance, normal, decreased resistance), abduction and adduction, and flexion and extension (Box 4-15). A thorough examination tests all muscle groups in both the upper and lower extremities.

Table 4-14. Muscle Strength Rating Scale

Scale	Meaning
0	No muscle contractility (complete paralysis)
1+	Barely detectable muscle contractility
2+	Active muscle contractility; unable to work against gravity
3+	Active muscle contractility; able to work against gravity but not against resistance
4+	Active muscle contractility; able to work against gravity and some resistance
5+	Active muscle contractility; able to work against gravity and full resistance (normal)

Box 4-15.
Motor Function Checklist

Patellar Reflex

- □ Position the patient correctly (sitting on the table edge or supporting the leg).
- □ Instruct the patient to relax the leg.
-

□ Palpate for the patellar tendon.

- □ Briskly tap the tendon once.
- □ The lower leg should extend in response to the stimulus.
- □ Report/record the results. (Example: Normal patellar reflex.)

Muscle Strength

- □ Steady the patient with the nondominant hand (sitting position only).
- □ Hold the extremity appropriately (do not hold or put pressure on the joint).
- □ Instruct the patient to push against resistance.
- □ Instruct the patient to pull against resistance.
- □ Report/record the results. (Example: Muscle strength is 5+.)

Muscle Tone

- □ Instruct the patient to relax the extremity.
- □ Support and stabilize the joint.
- □ Passively flex and extend the extremity (do not rotate the joint).
- □ Report/record the results. (Example: Normal muscle tone.)

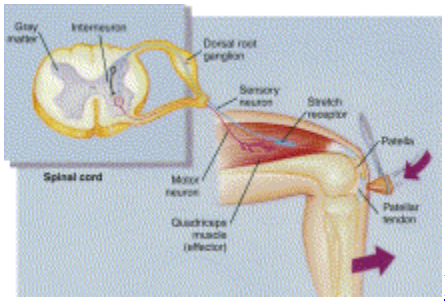
Cerebellar Function

The finger-to-nose test (see Box 4-14), heel-to-shin test, rapid alternating movements test (e.g., pronation and supination), Romberg test, and gait test are used to assess cerebellar function. For the finger-to-nose test hold your finger about an arm's length in front of the patient; ask the

patient to quickly and repeatedly touch his or her nose and then your finger. For the heel-to-shin test, instruct the patient to rub the heel down the shin of the opposite leg. The rapid alternating movements test is performed by asking the patient to pronate and supinate the hands rapidly and repeatedly. Romberg's test is performed by instructing the patient to stand with the feet together, arms extended with palms up, and eyes closed. Patients with normal posterior column function maintain the position without moving their feet for balance. Ask the patient to walk straight ahead, turn, return walking on tiptoes, turn, walk away on the heels, turn, and return walking heel to toe; observe the gait.

Reflexes

Assess for physiologic and pathologic reflexes. Ask the patient to relax the area being tested. Test the deep tendon reflexes by striking the tendon briskly with the reflex hammer; the pointed end of the triangular head is generally used (Figure 4-63). Test the superficial reflexes by gently tapping or stroking the area. Report the results using a plus scale (Table 4-15), with 0 representing complete absence of the reflex, 2+ representing a normal response, and 4+ representing marked hyperreactivity. Reflex test results are often documented using a stick figure representation (Figure 4-64).



Full-size image (48K)

Figure 4-63.

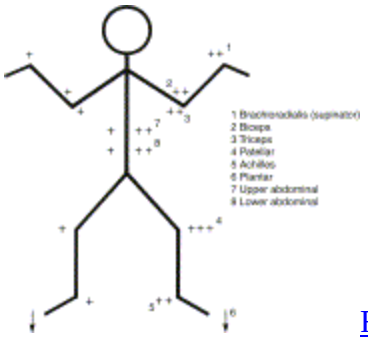
Patellar Reflex.

The patellar reflex is a simple reflex arc.

(From Thibodeau GA, Patton KT: *Anatomy and physiology*, ed 5, St Louis, 2003, Mosby.)

Table 4-15. Reflex Rating Scale

Scale	Meaning
0	No response
1+	Diminished response
2+	Normal physiologic response
3+	Increased response
4+	Hyperreactive; often associated with clonus



Full-size image (23K)

Figure 4-64.

Documentation of Reflexes.

Each physiologic reflex tests a different level of spinal cord function. The deep tendon (stretch) reflexes routinely tested include the biceps reflex (C5 and C6), the triceps reflex (C6 to C8), the brachioradialis reflex (C5 and C6), the patellar reflex (L2 to L4), and the Achilles reflex (S1 and S2) (Figure 4-65). The abdominal reflex is a commonly tested superficial reflex. The abdominal reflex is tested by stroking each side of the abdomen above the level of the umbilicus (T8 to T10) and below the level of the umbilicus (T10 to T12); the muscles normally reflexively tighten. The plantar reflex is tested by stroking the lateral aspect of the sole of the foot from the heel to the ball of the foot with a moderately sharp object, such as the handle of the reflex hammer; normally, the toes curl downward.

Full-size image (67K)

Figure 4-65.

Deep Tendon Reflexes.

A, Biceps. **B,** Brachioradial. **C,** Triceps. **D,** Patellar. **E,** Achilles.

(From Seidel HM: *Mosby's guide to physical examination*, ed 6, St. Louis, 2006, Mosby.)
A variety of pathologic reflexes indicate specific neurologic dysfunction (Table 4-16). An abnormal plantar reflex, known as *Babinski's reflex* or *sign* and indicative of upper motor neuron disease, is characterized by dorsiflexion of the great toe and spreading of the other four toes. The snout, grasp, and sucking reflexes are normally present in infancy but indicate neurologic abnormalities if present after infancy. Elicit the snout reflex by gently tapping the patient's face just above or below the lips; a positive response is characterized by puckering of the lips. Elicit

the grasp reflex by gently stroking the palm of the patient's hand between the thumb and fingers; a positive response is characterized by flexion of the fingers. Elicit the sucking reflex by gently stroking the patient's lips from side to center with a tongue depressor; a positive response is indicated by sucking movements. Elicit Hoffmann's reflex by dorsiflexing the patient's wrist with the fingers flexed and flicking the middle finger; a positive response is characterized by adduction of the thumb or index finger. The oculocephalic reflex, also known as the *doll's eye test*, is elicited by turning the patient's head quickly from side to side. If the brainstem is intact, the eyes move in the opposite direction and maintain the straight-ahead gaze. If the brainstem is not intact, the eyes move in the direction the head is turned. The oculovestibular reflex also tests brain function. The reflex is elicited by elevating the patient's head about 30 degrees and then instilling cold water in the ear canal. If the brainstem is intact, the normal neurologic response is the development of nystagmus.

Table 4-16. Reflexes Indicative of Neurologic Pathology

Reflex	**Significance**
Babinski's (plantar)	Extrapyramidal tract pathology
Snout	Diffuse brain disease
Sucking	Diffuse brain disease
Grasp	Prefrontal lobe lesions
Hoffmann's	Corticospinal tract dysfunction
Oculocephalic	Brainstem pathology
Oculovestibular	Brainstem pathology

Terminology

- **abduction:** Movement away from the midline of the body
- **abstract reasoning:** The ability to think beyond concrete terms
- **acalculia:** The inability to calculate
- **adduction:** Movement toward the midline of the body
- **affect:** The external expression of emotion
- **agraphia:** The inability to write
-

- **anosmia:** Complete loss of the sense of smell
- **anosognosia:** The inability to recognize one's own impairment
- **aphasia:** The inability to speak
- **aphonia:** The loss of voice
- **asterixis:** Involuntary movements characterized by nonrhythmic flapping of the extremities
- **athetosis:** Involuntary movements characterized by slow, twisting irregular motions
- **attention:** Mental focus or concentration
- **blocking:** Sudden interruption of speech in midsentence
- **chorea:** Involuntary movement characterized by brief, rapid, irregular, jerky motions
- **circumstantiality:** An abnormal thought process characterized by unnecessary detail that delays reaching the point of the thought
- **clanging:** The use of words on the basis of sound instead of meaning
- **clonus:** Rhythmic oscillation between extension and flexion
- **coma:** An altered state of consciousness characterized by complete loss of consciousness, unresponsiveness to stimuli, and absence of voluntary movement
- **confabulation:** Fabrication of facts or events to fill gaps in the memory
- **confusion:** An abnormality of consciousness characterized by mental slowness,

inattentiveness, and incoherent thought patterns

- **decerebrate rigidity:** An abnormal body posture observed in comatose patients characterized by clenched jaws, extension of the neck and legs, adduction of the arms, pronation of the forearms, and flexion of the wrists and fingers
- **decorticate rigidity:** An abnormal body posture observed in comatose patients characterized by flexion of the fingers and wrists and extension and internal rotation of the legs
- **delirium:** An abnormality of consciousness characterized by confusion, agitation, and hallucinations
- **dementia:** Acquired memory impairment
- **dysarthria:** Poorly coordinated, irregular speech
- **dyscalculia:** Difficulty calculating
- **dysgraphia:** Difficulty writing
- **dyslexia:** Difficulty reading
- **dysphasia:** Hesitancy and error in choosing words when speaking
- **dysphonia:** Hoarseness
- **dyspraxia:** Difficulty coordinating body movements
- **dystaxia:** Difficulty with muscle coordination
- **dystonia:** Abnormal slow, twitching, irregular movements

- **echolalia:** Repetition of words or phrases spoken by others
- **eversion:** The turning of the toes onto the great toe (bottom of the foot turned outward)
- **extension:** The bending of a joint to bring the joint parallel to the long axis
- **fasciculations:** Involuntary movements characterized by fine twitching that rarely moves a joint
- **flexion:** The bending of a joint to bring the parts of the joint into close approximation
- **flight of ideas:** An almost continuous flow of accelerated speech with quick changes of subject
- **hemianopsia:** A visual field defect associated with disorders of the optic chiasm or tract
- **hemiplegia:** Paralysis of one side of the body
- **incoherence:** An abnormal thought process characterized by illogical connections and quick changes of subject
- **intention tremor:** Involuntary movements characterized by tremors that are absent at rest but appear with intentional movement
- **inversion:** The turning of the toes onto the small toes (bottom of the foot turned inward)
- **judgment:** The ability to compare and evaluate alternatives
- **loose association:** Abnormal thought process characterized by repeated shifting to unrelated subjects
- **mood:** A sustained emotional state

- **myoclonus:** Involuntary movements characterized by sudden, brief, unpredictable jerks
- **neologism:** The use of invented words or the use of words with new meanings
- **nystagmus:** Involuntary oscillation of the eyeball; described as lateral if the eyeball oscillates from side to side, vertical if the eyeball oscillates up and down, and rotatory if the eyeball oscillates in a circle
- **ophthalmoplegia:** Optic movement disorder
- **paraparesis:** A slight degree of lower extremity paralysis
- **paraplegia:** Paralysis of the lower extremities and trunk
- **perseveration:** Persistent repetition of words or phrases
- **postural tremor:** Involuntary tremor that occurs when the affected part maintains a given position
- **pronation:** Placement into a downward-facing position
- **quadriplegia:** Paralysis of the upper and lower extremities
- **recent memory:** Memory of information acquired a few hours or days previously
- **remote memory:** Memory of information from the distant past
- **resting or static tremor:** Involuntary movement at rest
- **scotoma:** A visual field defect associated with disorders of the optic nerve
- **stereognosis:** The ability to identify, by touch, small objects placed in the hand

- **stupor:** An abnormal state of consciousness characterized by reduced mental and physical activity and reduced response to stimuli
- **supination:** Placement into an upward-facing position
- **thought content:** What a person thinks about
- **tics:** Involuntary movements characterized by brief, repetitive movements at irregular intervals

Application Activities

- 1. Develop your percussion technique by practicing the technique on various surfaces in your environment (e.g., walls, tables, stereo, cabinets, countertops). Work on developing a consistent percussion note over each surface and listen carefully to train your ears to distinguish between the densities of the objects percussed.
- 2. Compare blood pressure and heart rate when a person is sitting at rest and breathing normally with blood pressure and heart rate when the person takes a deep breath and holds it while the blood pressure and heart rate are measured. There will be differences. Explain why the differences occur.
- 3. Compare the blood pressure when a person is sitting at rest, squatting, and after running up and down several flights of stairs. There will be differences. Explain why the differences occur.

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Audio glossary terms

28 animations

14 checklists

8 videos

SELF-ASSESSMENT QUESTIONS

-

1. Which one of the following abbreviation-definition pairs is incorrect?
    - a. A&P—auscultation and percussion
    - b. NCAT—normocephalic atraumatic
    - c. RRR—regular rate and rhythm
    - d. CTA—clear to auscultation
    - e. MSE—minor system examination

2. The term *hyperopia* means which of the following?
    - a. Nearsightedness
    - b. Increased intraocular pressure
    - c. Farsightedness
    - d. Astigmatism
    - e. Abnormal protrusion of the eyeball

3. Which one of the following is *not* a fundamental physical assessment technique?
    - a. Percussion
    - b. Inspection
    - c. Auscultation

- d. Survey
- e. Palpation

4. Which one of the following apertures is used to assess undilated pupils?
   - a. Wide angle
   - b. Intermediate
   - c. Red free
   - d. Slit
   - e. Fixation target

5. Nails and nail beds are evaluated for which of the following?
   - a. Clubbing
   - b. Cyanosis
   - c. Trauma
   - d. All of the above
   - e. None of the above

6. Which of the following best describes the smell of the breath of a patient with severe liver disease?

- a. Fruity
- b. Urinous
- c. Alcoholic
- d. Sweet
- e. Musty

7. On the anterior view, where is the apex of the lung located?
    - a. About 3 to 4 cm above the medial end of the clavicles
    - b. Between the sixth and eighth ribs
    - c. Even with the clavicles
    - d. Below the tenth thoracic vertebra
    - e. About 3 to 4 cm below the lateral end of the clavicles

8. A patient’s muscle strength is noted to be 5+. What does this mean?
    - a. No muscle contractility
    - b. Barely detectable muscle contractility
    - c. Active muscle contractility; able to work against gravity and full resistance

- d. Active muscle contractility; able to work against gravity but not resistance
- e. Active muscle contractility; able to work against gravity and some resistance

9. The normal liver span along the midclavicular line is how long?
    - a. 5 cm
    - b. 7 cm
    - c. 10 cm
    - d. 14 cm
    - e. 20 cm

10. Asking the patient to interpret common proverbs assesses which of the following?
    - a. Long-term memory
    - b. Abstract thinking
    - c. Judgment
    - d. Praxis
    - e. Affect

11. Which of the following breath sounds is normally heard over the far lateral chest?

- a. Tracheal
- b. Bronchial
- c. Bronchovesicular
- d. Vesicular

12. Which cardiac ausculatory position is located at the second intercostal space left sternal border?
    - a. Aortic
    - b. Pulmonic
    - c. Tricuspid
    - d. Mitral

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Chapter 5 - Review of Laboratory and Diagnostic Tests
Learning Objectives•Differentiate between invasive and noninvasive tests.•State the clinical application of common general diagnostic procedures.•Identify the clinical application of specific laboratory tests.•Identify the clinical application of specific diagnostic procedures.•Assess common laboratory and diagnostic test results.•Define the following terms: biomarker, traditional biomarker, preventive biomarker, diagnostic biomarker, prognostic biomarker, predictive biomarker, proximal biomarker, distal biomarker, and standard biomarker.

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Chapter Outline

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            - Biopsy
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            - Doppler Echography
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            - Fluoroscopy
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            - Molecular Imaging
            - Paracentesis
            - Plethysmography
            - Positron Emission Tomography
            - Radionuclide Studies
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            - Cholesterol
            - C-Reactive Protein
            - Lactate Dehydrogenase

        - Myoglobin
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        - Troponins
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        - Central Line Placement with Hemodynamic Monitoring
        - Chest Radiography
        - Coronary Angiography
        - Digital Subtraction Angiography
        - Echocardiography
            -
            - Contrast echocardiography
            - Doppler echocardiography
            - Exercise echocardiography
            - M-mode echocardiography
            - Two-dimensional echocardiography
        - Electrocardiography
            -
            - Electrocardiogram
            - Electrocardiogram with stress (stress test)
            - Holter monitoring (ambulatory electrocardiography)
            - Thallium stress test
        - Intracardiac Electrophysiologic Studies
        - Lymphoscintigraphy
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        - Adrenal Tests
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            - Adrenal medulla
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                -
                - Dexamethasone suppression test
                - Insulin tolerance test
                - Metyrapone test
        - Pancreatic Tests
            -
            - Amylase
            - C peptide
            - Glucose
            - Fasting serum glucose
            - Glucose tolerance test

        - Random serum glucose
        - Glycosylated hemoglobin
        - Insulin
        - Lipase
    - Parathyroid Tests
    - Pituitary Tests
        -
        - Anterior pituitary
            -
            - Adrenocorticotropic hormone stimulation test
        - Posterior pituitary
    - Thyroid Tests
        -
        - Free thyroxine index
        - Thyroid-stimulating hormone (thyrotropin)
        - Thyroid uptake of radioiodine
        - Thyrotropin-releasing hormone
        - Triiodothyronine uptake
- Gastrointestinal System
    -
    - Laboratory Tests
        -
        - Biliary System
            -
            - Alkaline phosphatase
            - Direct bilirubin
            - Delta bilirubin
            - Indirect bilirubin
            - Total bilirubin
        - Hepatic Synthetic Function
            -
            - Ammonia
            - Protein production
                -
                - Albumin
                - Vitamin K–dependent clotting factors (factors II, VII, IX, and X)
        - Hepatocellular Enzymes
            -
            - Alanine aminotransferase
            - Aspartate aminotransferase
            - Gamma glutamyl transpeptidase
            - Lactate dehydrogenase
        - Stool
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            -

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            - Serum/ascites albumin gradient
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        - Endoscopic Retrograde Cholangiopancreatography
        - Endoscopy
        - Esophagogastroduodenoscopy
        - Intragastric pH
        - Manometry
        - Percutaneous Transhepatic Cholangiography
        - pH Stimulation Tests
        - Schilling Test
        - Sigmoidoscopy
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    - General Laboratory Tests
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        - ABO Blood Typing
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            -
            - Bleeding time
            - Partial thromboplastin time, activated
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- Red Blood Cells
  -
  - Carboxyhemoglobin.
  - Coombs' test
    -
    - Direct Coombs' test
    - Indirect Coombs' test
  - Erythrocyte sedimentation rate
  - Folate
  - Hematocrit
  - Hemoglobin
  - Iron metabolism
    -
    - Ferritin
    - Iron
    - Total iron-binding capacity
    - Transferrin saturation
  - Red blood cell appearance
    -
    - Acanthocytes
    - Anisocytosis
    - Burr cells
    - Elliptocytes
    - Hypochromia
    - Macrocytes
    - Microcytes
    - Normochromia
    - Normocytes
    - Ovalocytes
    - Schistocytes
    - Spherocytes
    - Stomatocytes
    - Target cells
  - Red blood cell count
  - Red blood cell inclusions
    -
    - Basophilic stippling
    - Heinz bodies
    - Howell-Jolly bodies
    - Nucleated red blood cells
  - Red blood cell indices
    -
    - Mean corpuscular hemoglobin
    - Mean corpuscular hemoglobin concentration
    - Mean cell volume

        - Red cell distribution width
        - Reticulocytes
        - Vitamin B_{12}
    - White Blood Cells
        -
        - Granulocytes
            -
            - Basophils
            - Eosinophils
        - Neutrophils
        - Lymphocytes
        - Monocytes
- Diagnostic Procedure
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    - Bone Marrow Aspiration
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- Laboratory Tests
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    - Autoantibodies
        -
        - Antineutrophil cytoplasmic antibodies
        - Antinuclear antibodies
        - Anti-DNA antibodies
        - Extractable nuclear antigens
        - Rheumatoid factors
    - Cold Agglutinins
    - Coombs' Test
        -
        - Direct Coombs' test
        - Indirect Coombs' test
    - Complement
    - Complement Components 3 and 4
    - C-Reactive Protein
    - Erythrocyte Sedimentation Rate
    - Immunoelectrophoresis
    - Immunoglobulin E
    - Lupus Anticoagulant
    - Organ-Specific Autoantibodies
    - Protein Electrophoresis
    - Synovial Fluid Analysis
        -
        - Calcium pyrophosphate crystals
        - Monosodium urate crystals
    - Uric Acid
    - Venereal Disease Research Laboratory Test

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        - Color
        - Glucose
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        - Other tests
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      - Electromyography
      - Peripheral Nerve Stimulation
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- Nutrition
  -
  - Laboratory Tests

        -
        - Albumin
        - Bilirubin
        - Calcium
        - Creatinine
        - Glucose
        - Immunologic Status
        - Magnesium
        - Partial Thromboplastin Time, Activated
        - Phosphorus
        - Transaminases
        - Transferrin
        - Urea Nitrogen, Blood
    - Diagnostic Procedure
        -
        - Anthropometrics
- Renal System
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    - Laboratory Tests
        -
        - Arterial Blood Gases
            -
            - Arterial pH
            - Base excess
            - Bicarbonate
            - Carbon dioxide tension
            - Oxygen saturation
            - Oxygen tension
        - Creatinine
        - Electrolytes and Minerals
            -
            - Calcium (ionized)
            - Calcium (total)
            - Chloride
            - Magnesium
            - Phosphorus
            - Potassium
            - Sodium
        - Gram Staining and Culture
        - Osmolality
        - Urea Nitrogen, Blood
        - Urinary Sodium
        - Urine Toxicologic Testing
        - Urinalysis
            -
            - Dipstick screening

        -
        - Bilirubin
        - Blood
        - Glucose
        - Ketones
        - Leukocyte esterase
        - Nitrites
        - pH
        - Protein
    - Specific gravity
    - Urobilinogen
    - Macroscopic assessment
        -
        - Color
        - Turbidity
        - Odor
    - Microscopic assessment
        -
        - Casts
            -
            - Bile casts
            - Granular casts
            - Hemoglobin casts
            - Hyaline casts
            - Mixed cellular casts
            - Red blood cell casts
            - Renal tubular epithelial cell casts
            - Waxy casts
            - White blood cell casts
        - Cells
            -
            - Red blood cells
            - Renal tubular epithelial cells
            - Squamous epithelial cells
            - White blood cells
        - Crystals
            -
            - Bilirubin crystals
            - Calcium oxalate crystals
            - Cholesterol crystals
            - Cystine crystals
            - Leucine crystals
            - Tyrosine crystals
- Diagnostic Procedures
    -
    - Intravenous Pyelography

        -
        - Retrograde pyelography
- Respiratory System
    -
    - Laboratory Tests
        -
        - Arterial Blood Gases
        - Carboxyhemoglobin
        - Venous Blood Gases
        - Sputum Analysis
            -
            - Macroscopic assessment
                -
                - Color
                - Odor
                - Viscosity
                - Volume
            - Microscopic assessment
                -
                - Charcot-Leyden crystals
                - Curschmann’s spirals
                - Eosinophils
                - Neutrophils
    - Diagnostic Tests and Procedures
        -
        - Bronchoscopy
        - Chest Radiography
        - Pleural Fluid Analysis
            -
            - Color
            - Fluid character
            - Fluid odor
            - Transudate versus exudate
            - Other laboratory tests
        - Pulmonary Function Testing
            -
            - Carbon monoxide diffusing capacity
            - Forced expiratory volume in 1 second
            - Forced vital capacity
            - Peak expiratory flow rate
            - Residual volume
            - Tidal volume
            - Pulse oximetry
            - Quantitative pilocarpine iontophoresis (sweat test)
            - Ventilation/perfusion scanning
- Biomarkers

-
  - Pharmacogenetic Biomarkers
  - Cardiac Biomarkers
  - Cancer Biomarkers
  - Kidney Biomarkers
  - Other Disease-Specific Biomarkers
    -
      - Alzheimer’s Disease
      - Sepsis
  - Application Activities
- References

Data from laboratory and diagnostic tests and procedures provide important information regarding the response to drug therapy, the ability of patients to metabolize and eliminate specific therapeutic agents, the diagnosis of disease, and the progression and regression of disease.

This chapter reviews the laboratory and diagnostic tests commonly encountered in the patient care environment. The tests are presented using an organ system approach (i.e., cardiovascular, endocrine, gastrointestinal, hematologic, immunologic, neurologic, renal, and respiratory); separate sections for the assessment of infectious diseases and nutritional status are included. More detailed information about these and other laboratory and diagnostic tests is available in laboratory and medicine textbooks and the current literature.

Background

Laboratory and diagnostic tests are classified as either *invasive* or *noninvasive* tests. *Invasive* tests are those that require penetration of the skin or insertion of instruments or devices into a body orifice. The degree of risk from invasive tests ranges from relatively minor risks such as the pain, bleeding, and bruising associated with venipuncture to the risk of death associated with more invasive procedures such as coronary angiography. Examples of invasive tests include collection of blood (venipuncture), insertion of a central venous catheter, and collection of cerebrospinal fluid (CSF). *Noninvasive* tests do not require penetration of the skin or insertion of instruments or devices into body orifices and pose little risk to the patient. Examples of noninvasive tests are the chest radiograph, analysis of spontaneously voided urine, and stool occult blood analysis.

The selection of specific tests and procedures depends on the patient’s underlying condition, the need for the information, and the degree of risk. For example, venipuncture may be considered too invasive for patients with chronic stable disease, but it may be essential when initiating drug treatment for a patient with unstable disease.

Reference ranges for various tests are listed in Table 5-1, Table 5-2, Table 5-3, Table 5-4, Table 5-5, Table 5-6 and Table 5-7.[1.] and [2.]Individual laboratory test results are interpreted using laboratory-specific reference ranges. Reference ranges may differ among different laboratories depending on the population tested and the laboratory methods used to establish the range.

Statistically derived reference ranges encompass the tested mean ±2 standard deviations. This means that 1 in 20 normal test results fall outside the reference range.

Table 5-1. Adult Cardiovascular Laboratory Reference Values (Based on Serum Tests)
Data from Kratz A, Ferraro M, Sluss PM, et al: Laboratory reference values. *N Engl J Med* 351:1548-1563, 2004; Sacher RA, McPherson RA: *Widmann's clinical interpretation of laboratory tests,* ed 11, Philadelphia, 2000, FA Davis.

Index	**Reference Range**
Creatine kinase	
Female	40-150 units/L
Male	60-400 units/L
Creatine kinase MB fraction (CK-MB)	0-7 ng/mL
C-reactive protein	0.08-3.1 mg/L
Lactic dehydrogenase (LDH)	100-190 units/L
LDH isoenzymes	
LDH_1	14-26%
LDH_2	29-39%
LDH_3	20-26%
LDH_4	8-16%
LDH_5	6-16%
Lipids	
Cholesterol, total	<200 mg/dL
Triglycerides, fasting	<160 mg/dL
Troponins	
Troponin I	0-0.4 ng/mL
Troponin T	0-0.1 ng/mL

Table 5-2. Adult Endocrine Laboratory Reference Values
Data from Kratz A, Ferraro M, Sluss PM, et al: Laboratory reference values. *N Engl J Med* 351:1548-1563, 2004; Sacher RA, McPherson RA: *Widmann's clinical interpretation of laboratory tests,* ed 11, Philadelphia, 2000, FA Davis.

Index	**Source**	**Reference Range**
THYROID		
Free thyroxine index	S	4.6-11.2
Thyroid-stimulating hormone (TSH)	S	0.5-4.7 μU/mL
Total triiodothyronine (T_3)	S	60-181 ng/dL
Total thyroxine (T_4)	S	4.5-10.9 mcg/dL
PITUITARY		

Index	Source	Reference Range
Adrenocorticotropic hormone (ACTH)	P	6-76 pg/mL
Growth hormone (fasting)	S	0.5-17.0 ng/mL
Prolactin		
Female	S	0-20 ng/mL
Male	S	0-15 ng/mL
ADRENAL CORTEX		
Aldosterone (recumbent, normal salt diet)	S, P	2-9 ng/dL
Cortisol (8 AM fasting)	P	0-10 mcg/dL
Renin (6 hr, recumbent, normal salt diet)	P	0.5-1.6 ng/mL/hr
ADRENAL MEDULLA AND CATECHOL SECRETIONS		
Epinephrine	U	0-20 mcg/24 hr
Norepinephrine	U	15-80 mcg/24 hr
Vanillylmandelic acid (VMA)	U	0.15-1.2 mg/24 hr
GONADS		
Estradiol		
Female		
Premenopausal	S, P	<20-443 pg/mL
Postmenopausal	S, P	<59 pg/mL
Male	S, P	<20 pg/mL
Testosterone		
Female	S	6-86 ng/dL
Male	S	270-1070 ng/dL
PANCREAS		
Amylase	S	60-180 units/L
Glucose (fasting)	P	75-115 mg/dL
Insulin (fasting)	S, P	2-20 μU/mL
Lipase	S	0-160 units/dL
PARATHYROID		
Calcium	S	9.0-10.5 mg/dL
Parathyroid hormone	P, S	10-60 pg/mL
Phosphorus	S	3.0-4.5 mg/dL

P, Plasma; *S*, serum; *U*, urine.

Table 5-3. Adult Gastrointestinal Laboratory Reference Values

Data from Kratz A, Ferraro M, Sluss PM, et al: Laboratory reference values. *N Engl J Med* 351:1548-1563, 2004; Sacher RA, McPherson RA: *Widmann's clinical interpretation of laboratory tests,* ed 11, Philadelphia, 2000, FA Davis.

Index	**Source**	**Reference Range**
Alanine aminotransferase (ALT)	S	0-35 units/L
Alkaline phosphatase	S	30-120 units/L
Ammonia	P	10-80 mcg/dL
Aspartate aminotransferase (AST)	S	0-35 units/L
Bilirubin		
Total	S	0.3-1.0 mg/dL
Direct	S	0.1-0.3 mg/dL
Indirect	S	0.2-0.7 mg/dL
Delta		
Gamma glutamyl transpeptidase (GGT)	S	1-94 units/L
Lactate dehydrogenase (LDH)	S	100-190 units/L
Partial thromboplastin time, activated (aPTT)	P	22-35 sec
Protein		
Albumin	S	3.5-5.5 g/dL
Globulin	S	2.0-3.5 g/dL
Total	S	5.5-8.0 g/dL
Prothrombin time (PT)	P	11-13 sec
Stool fat	Stool	1-7 g/day

P, Plasma; *S,* serum.

Table 5-4. Adult Hematology Laboratory Reference Values

Data from Kratz A, Ferraro M, Sluss PM, et al: Laboratory reference values. *N Engl J Med* 351:1548-1563, 2004; Sacher RA, McPherson RA: *Widmann's clinical interpretation of laboratory tests,* ed 11, Philadelphia, 2000, FA Davis.

Index	**Source**	**Reference Range**
Bleeding time		2.0-9.5 min
Blood volume		8.5-9.5% of body weight in kg
Erythrocyte count (RBCs)		
Female	WB	$4.0\text{-}5.2 \times 10^6/mm^3$
Male	WB	$4.5\text{-}5.9 \times 10^6/mm^3$
Erythrocyte sedimentation rate (ESR)		
Female	WB	1-25 mm/hr
Male	WB	1-17 mm/hr
Ferritin		

Index	Source	Reference Range
Female	S	10-200 ng/mL
Male	S	30-300 ng/mL
Fibrin degradation products	P	<2.5 mcg/mL
Folic acid	S, P	3.1-17.5 ng/mL
Hematocrit		
Female	WB	36-46%
Male	WB	41-53%
Hemoglobin		
Female	WB	12-16 g/dL
Male	WB	13.5-17.5 g/dL
Hemoglobin A_{1C}	WB	3.8-6.4%
Iron	S	30-160 mcg/dL
Iron-binding capacity	S	228-428 mcg/dL
Leukocyte count (WBCs)	WB	$4.5\text{-}11.0 \times 10^3/mm^3$
T lymphocytes	WB	74-86% of circulating lymphocytes
B lymphocytes	WB	5-25% of circulating lymphocytes
T4 lymphocytes (CD4)	WB	38-52% of circulating lymphocytes
T8 lymphocytes (CD8)	WB	22-36% of circulating lymphocytes
T4/T8 ratio		1.0:2.2
Mean corpuscular volume (MCV)	WB	$80\text{-}100\ \mu m^3$
Mean corpuscular hemoglobin (MCH)	WB	26-34 pg/cell
Mean cell hemoglobin concentration (MCHC)	WB	31-37 g/dL
Partial thromboplastin time, activated (aPTT)	P	22-35 sec
Platelet count	WB	$150\text{-}350 \times 10^3/mm^3$
Prothrombin time (PT)	P	11-13 sec
Red cell distribution width	WB	11.5-14.5%
Reticulocyte count	WB	0.5-2.5% of red cells
Thrombin time	P	Control ± 5 sec
Vitamin B_{12}	S, P	>250 pg/mL

P, Plasma; *S,* serum; *WB,* whole blood.

Table 5-5. Adult Immunologic Laboratory Reference Values (Based on Serum Tests)
Data from Kratz A, Ferraro M, Sluss PM, et al: Laboratory reference values. *N Engl J Med* 351:1548-1563, 2004; Sacher RA, McPherson RA: *Widmann's clinical interpretation of laboratory tests,* ed 11, Philadelphia, 2000, FA Davis.

Index	Reference Range

Index	Reference Range
Alpha$_1$ antitrypsin	85-213 mg/dL
Alpha fetoprotein	<15 IU/mL
Antineutrophil cytoplasmic antibodies	Negative
Antinuclear antibodies	Negative at 1:40 dilution
Anti–native DNA antibodies	Negative at 1:10 dilution
Anti-Smith antibodies	Negative
Anti–ribonucleic protein antibodies	Negative
Antibodies to SS-A (Ro)	Negative
Antibodies to SS-B (La)	Negative
Complement	
C3	86-184 mg/dL
C4	20-58 mg/dL
Total hemolytic (CH_{50})	150-250 units/mL
Rheumatoid factor	<30 IU/mL
Uric acid	
Female	1.5-6.0 mg/dL
Male	2.5-8.0 mg/dL

Table 5-6. Adult Nutritional Laboratory Reference Values
Data from Kratz A, Ferraro M, Sluss PM, et al: Laboratory reference values. *N Engl J Med* 351:1548-1563, 2004; Sacher RA, McPherson RA: *Widmann's clinical interpretation of laboratory tests,* ed 11, Philadelphia, 2000, FA Davis.

Index	Source	Reference Range
Alanine aminotransferase (ALT)	S	0-35 units/mL
Aspartate aminotransferase (AST)	S	0-35 units/mL
Bilirubin		
Direct	S	0.1-0.3 mg/dL
Indirect	S	0.2-0.7 mg/dL
Total	S	0.3-1.0 mg/dL
Blood urea nitrogen (BUN)	S	10-20 mg/dL
Calcium, ionized	WB	4.5-5.6 mg/dL
Calcium, total	S	9.0-10.5 mg/dL
Glucose (fasting)	P	75-115 mg/dL
Hemoglobin		
Female	WB	12-16 g/dL
Male	WB	13.5-17.5 g/dL

Index	Source	Reference Range
Iron	S	30-160 mcg/dL
Magnesium	S	1.8-3.0 mEq/L
Partial thromboplastin time, activated (aPTT)	P	22-35 sec
Phosphorus, inorganic	S	3-4.5.0 mg/dL
Protein		
Albumin	S	3.5-5.5 g/dL
Total	S	5.5-8.0 g/dL
Total	U	<165 mg/day
Transferrin	S	230-390 mg/dL

P, Plasma; *S*, serum; *U*, urine; *WB*, whole blood.

Table 5-7. Adult Renal and Mineral Laboratory Reference Values

Data from Kratz A, Ferraro M, Sluss PM, et al: Laboratory reference values. *N Engl J Med* 351:1548-1563, 2004; Sacher RA, McPherson RA: *Widmann's clinical interpretation of laboratory tests*, ed 11, Philadelphia, 2000, FA Davis.

Index	Source	Reference Range
Arterial blood gases		
pH	WB	7.35-7.45
P_{CO_2}	WB	35-45 mm Hg
P_{O_2}	WB	75-100 mm Hg
Bicarbonate	WB	21-30 mEq/L
Oxygen saturation	WB	96-100%
Base excess	WB	−2 to +2
Venous blood gases		
pH	WB	7.32-7.43
P_{CO_2}	WB	38-50 mm Hg
P_{O_2}	WB	40 mm Hg
Oxygen saturation	WB	60-85%
Calcium, ionized	WB	4.5-5.6 mg/dL
Calcium, total	S	9.0-10.5 mg/dL
CO_2 content	P	21-30 mEq/L
Chloride	S	98-106 mEq/L
Creatinine	S	<1.5 mg/dL
Creatinine	U	1.0-1.6 g/24 hr
Magnesium	S	1.8-3.0 mEq/L
Phosphorus	S	3.0-4.5 mg/dL

Index	Source	Reference Range
Potassium	S	3.5-5.0 mEq/L
Potassium	U	25-100 mEq/24 hr
Protein	U	<150 mg/24 hr
Sodium	S	135-145 mEq/L
Sodium	U	100-260 mEq/24 hr
Specific gravity	U	1.001-1.035
Urea nitrogen	S	10-20 mg/dL
Urea nitrogen	U	6-17 g/24 hr
Urine pH	U	5-9

P, Plasma; P_{CO_2}, carbon dioxide partial pressure; P_{O_2}, oxygen partial pressure; *S*, serum; *U*, urine; *WB*, whole blood.

Factors to consider when interpreting individual test results include patient age, gender, timing of the test result in relationship to drug administration, concomitant drug therapy, concurrent diseases, organ function (e.g., renal function, liver function, cardiac function), test sensitivity (the proportion of true-positive results), test specificity (the proportion of true-negative results), timing of the test in relation to drug dosing or known circadian rhythms, genetics (e.g., glucose-6-phosphate deficiency), and fluid status (e.g., euvolemia, dehydration, fluid overload). Refer to laboratory textbooks or the published literature for detailed discussions of these factors.

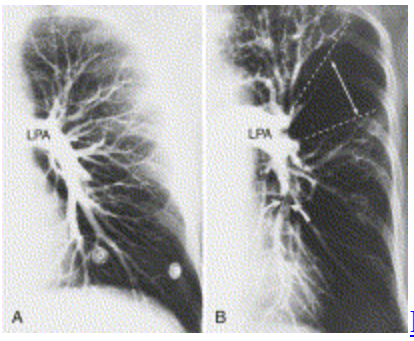
General Organ Systems

A variety of tests and procedures are used to diagnose and monitor conditions that affect various organ systems. The applications and uses of these tests and procedures continue to expand with experience and the integration of new technology.

Laboratory Tests and Diagnostic Procedures

Angiography

Angiography is a radiographic test used to evaluate blood vessels and the circulation (Figure 5-1). Radiopaque material is injected through a catheter inserted in the blood vessel, and images are recorded using standard radiographic techniques.



Full-size image (38K)

Figure 5-1.

Angiography.

Pulmonary angiogram showing normal vasculature (**A**) and the wedge-shaped absence of blood vessels (*area between dotted lines*) associated with pulmonary emboli (**B**)

(From Metter F: *Essentials of radiology*, ed 2, St Louis, 2004, Saunders.)

Biopsy

A biopsy involves the removal and evaluation of tissue.

Computed Tomography

Computed tomography (CT scan) uses a computerized x-ray system to produce detailed sectional x-ray images (Figure 5-2). The system is very sensitive to differences in tissue density and produces detailed two-dimensional planar images; the use of contrast agents increases attenuation. In spiral or helical CT scanning pictures are taken continuously, which decreases the time needed to obtain images.

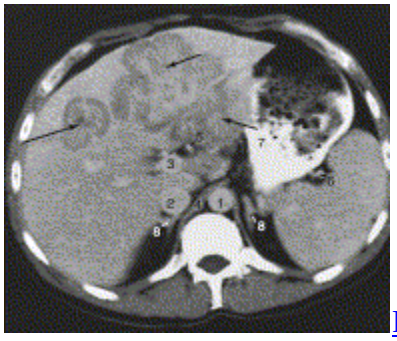

Full-size image (38K)

Figure 5-2.

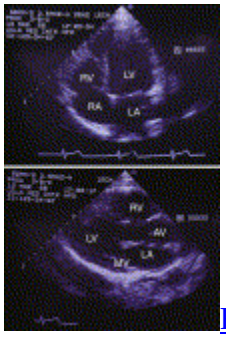
Computed Tomography.

Hematoma (*arrows*) of the lateral and medial segments of the left lobe of the liver is visible on this computed tomographic image. *1,* Aorta; *2,* inferior vena cava; *3,* portal vein; *4,* crus; *5,* hepatic artery; *6,* splenic artery; *7,* stomach; *8,* adrenal glands.

(From Seecram E: *Computed tomography: physical principles, clinical applications and quality control,* ed 3, St Louis, 2009, Saunders.)

Doppler Echography

Doppler echography uses ultrasound technology to measure shifts in frequency caused by object movement (Figure 5-3). For example, Doppler echography is used to evaluate blood flow velocity and turbulence in the heart (Doppler echocardiography) and peripheral circulation.



Full-size image (45K)

Figure 5-3.

Echocardiography.

Two-dimensional echocardiogram. *AV,* Aortic valve; *LA,* left atrium; *LV,* left ventricle; *MV,* mitral valve; *RA,* right atrium; *RV,* Right ventricle.

(From Canobbio MM: *Cardiovascular disorders,* St Louis, 1990, Mosby.)

Endoscopy

Endoscopy is used to examine the interior of a hollow viscus (e.g., digestive, respiratory, and urogenital organs and the endocrine system) or canal (e.g., bile ducts, pancreas). The endoscope, a flexible or inflexible tube with a camera and light source, is inserted into a body orifice (Figure 5-4). Still and/or video images are recorded and biopsy specimens are obtained for tissue examination or other laboratory diagnostic tests (Figure 5-5). Examples of common endoscopic procedures are colonoscopy (Figure 5-6) (views the inside of the entire colon from the rectum to the end of the small intestine), sigmoidoscopy (views the inside of the large intestine from the rectum through the sigmoid colon), cholangiopancreatography (views the inside of the bile ducts and pancreas), esophagogastroduodenoscopy (Figure 5-7) (views the inside of the esophagus, stomach, and duodenum), and bronchoscopy (Figure 5-8) (views the inside of the tracheobronchial tree).

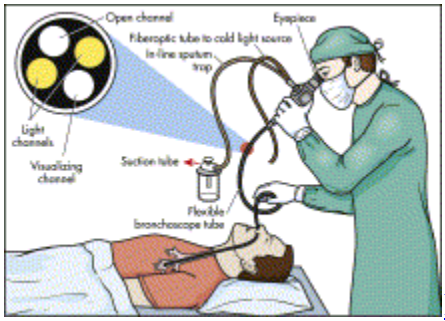
Full-size image (33K)

Figure 5-4.

Endoscopy.

Endoscope used to perform esophagogastroduodenoscopy.

(From Doughty D: *Gastrointestinal Disorders*, St Louis, 1993, Mosby.)



Full-size image (63K)

Figure 5-5.

Bronchoscopy.

Flexible four-channel fiberoptic bronchoscope used to perform bronchoscopy.

(From Pagana K, Pagana T: *Mosby's manual of diagnostic and laboratory tests*, ed 4, St Louis, 2010, Mosby.)

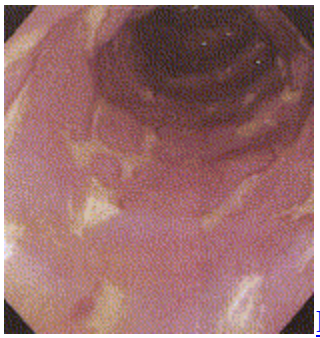

Full-size image (22K)

Figure 5-6.

Colonoscopy.

Crohn’s disease (regional enteritis) in a portion of intestine visualized through an endoscope.

(From Copstead-Kirkhorn LE, Banasik J: *Pathophysiology*, ed 4, St Louis, 2010, Saunders.)

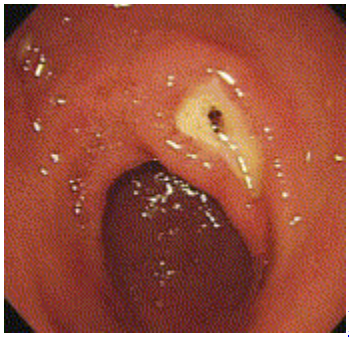
 Full-size image (39K)

Figure 5-7.

Endoscopy.

Gastric ulcer visualized through an endoscope (yellow-based ulceration with a pigmented spot).

(From Andreoli T, et al: Andreoli and Carpenter’s Cecil Essentials of Medicine, ed 7, Philadelphia, 2007, Saunders.)

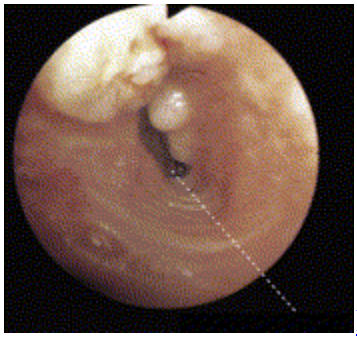
 Full-size image (19K)

Figure 5-8.

Bronchoscopy.

Squamous cell carcinoma at the opening of the left upper lobe bronchus (*tip of dotted line*) visualized through a bronchoscope.

(From Forbes CD, Jackson WF, *Color atlas and text of clinical medicine*, ed 3, St Louis, 2003, Mosby.)

Fluoroscopy

Fluoroscopy uses a fluoroscope, a device that makes the shadows of x-rays visible, to provide real-time visualization of procedures. Fluoroscopy exposes a patient to more radiation than routine radiography but often is used to guide needle biopsy procedures and nasogastric tube advancement.

Magnetic Resonance Imaging

Magnetic resonance imaging (MRI) uses an externally applied magnetic field to align the axis of nuclear spin of cellular nuclei (Figure 5-9). The patient is surrounded by the magnetic field. Brief radiofrequency pulses are applied to displace the alignment. The energy emitted when the displacement ends is detected, which allows finely detailed planar and three-dimensional images to be produced; the use of contrast agents increases the attenuation (Figure 5-10).

Full-size image (56K)

Figure 5-9.

Magnetic Resonance Imaging.

Magnetic resonance imaging uses an externally applied magnetic field to obtain detailed images of anatomic structures. **A,** open MRI. **B,** closed MRI.

Full-size image (26K)

Figure 5-10.

Magnetic Resonance Imaging.

Magnetic resonance image of the anterior knee. *1*, Iliotibial band; *2*, lateral meniscus; *3*, Gerdy's tubercle; *4*, medial meniscus; *5*, medial collateral ligament.

(From Ryan S, et al: *Anatomy for diagnostic imaging*, ed 2, Edinburgh, 2004, Saunders.)

Molecular Imaging

Molecular imaging is an investigational technology that assesses biologic processes at the cellular and subcellular level in living tissue. Areas of interest include the biology of cancer and cardiovascular disease.

Paracentesis

Paracentesis is the removal and analysis of fluid from a body cavity. In abdominal paracentesis fluid is removed from the abdominal cavity (Figure 5-11). In thoracocentesis fluid is removed from the pleural space (Figure 5-12).

Full-size image (22K)

Figure 5-11.

Abdominal Paracentesis.

In abdominal paracentesis a large needle is used to drain fluid from the abdominal cavity.

(From Leonard P: *Building a medical vocabulary with Spanish translations*, ed 7, St Louis, 2009, Saunders.)

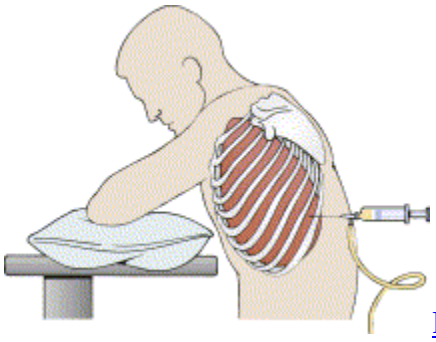

Full-size image (22K)

Figure 5-12.

Thoracocentesis.

In thoracocentesis a needle is used to drain fluid from the pleural space.

(From Beare PG, Myers JL: *Principles and practice of adult health nursing*, ed 3, St Louis, 1998, Mosby.)

Plethysmography

Plethysmography assesses changes in the size of vessels and hollow organs by measuring displacement of air or fluid from a containment system (Figure 5-13). Body plethysmography is used to assess pulmonary function.

Full-size image (35K)

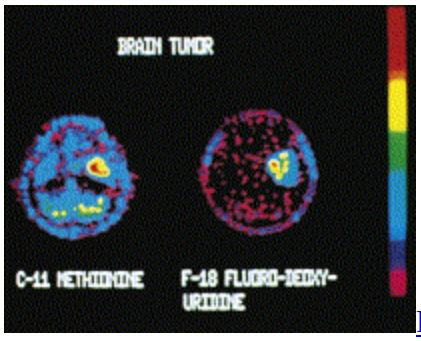
Figure 5-13.

Body Plethysmography.

(Courtesy Medical Graphics, Inc., St. Paul, MN.)

Positron Emission Tomography

Positron emission tomography (PET) imaging uses positron-emitting radionuclides (e.g., fluorodeoxyglucose F 18) to visualize organs and tissues of the body (Figure 5-14). The radionuclides decay, producing positrons that collide with electrons. A special camera detects photons released when the positrons and electrons collide. PET imaging provides quantitative information regarding the structure and function of organs and tissues. PET is commonly used to detect and monitor malignancies.



Full-size image (28K)

Figure 5-14.

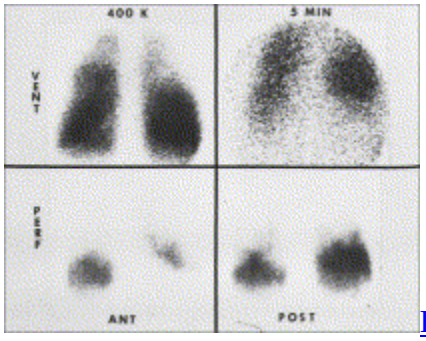
Positron Emission Tomography.

Brain tumor visualized on a positron emission tomographic scan.

(From Pagana K, Pagana T: *Mosby's manual of diagnostic and laboratory tests*, ed 4, St Louis, 2010, Mosby.)

Radionuclide Studies

Radionuclide studies involve the administration of oral, parenteral, or inhaled radioactive chemicals or pharmaceuticals. X-ray images, usually serial, record the collection and dispersion of the radioactive material. The ventilation-perfusion scan of the lungs (Figure 5-15) and the bone scan (Figure 5-16) are examples of radionuclide studies.



Full-size image (33K)

Figure 5-15.

Ventilation/Perfusion Scanning.

Decreased perfusion of the right upper and left upper lobes is visualized on the perfusion scans. Ventilation is normal. **Vent,** Ventilator. **Perf,** Perfusion. **Ant,** Anterior. **Post,** Posterior.

(From Christian P, Waterstram-Rich K: *Nuclear medicine and PET/CT*, St Louis, 2007, Mosby)

Full-size image (41K)

Figure 5-16.

Bone Scanning.

A, Upper body scan showing normal radionuclide uptake. **B,** Lower body scan showing increased radionuclide uptake in the right ilium, ischium, and pubic bones consistent with Paget's disease.

(From Pagana K, Pagana T: *Mosby's manual of diagnostic and laboratory tests*, ed 4, St Louis, 2010, Mosby.)

Single-Photon Emission Computed Tomography

Single-photon emission computed tomography (SPECT) is similar to PET but involves the administration of radionuclides that emit gamma rays (Figure 5-17). SPECT is less expensive than PET but provides more limited image resolution. SPECT is commonly used to assess the coronary arteries, bone, brain, prostate, and thyroid.

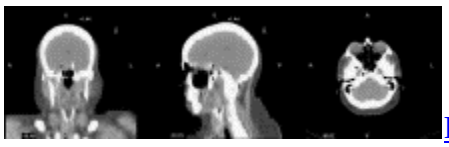

Full-size image (27K)

Figure 5-17.

Single-Photon Emission Computed Tomography.

Pituitary adenoma (black markers) visualized with computed tomography corrected single-photon emission computed tomography.

(From Christian P, Waterstram-Rich K: *Nuclear medicine and PET/CT*, St Louis, 2007, Mosby.)

Standard Radiography (Plain Films, X-Ray Films)

In standard radiography images are produced on photographic plates by passing x-rays (roentgen rays) through the body (Figure 5-18). These films are sometimes difficult to interpret because the

three dimensionality is lost on the planar images. Film-based radiography is being replaced by digital imaging, in which a flat-panel imager containing thousands of independent semiconductor detectors is used instead of film.

Full-size image (39K)

Figure 5-18.

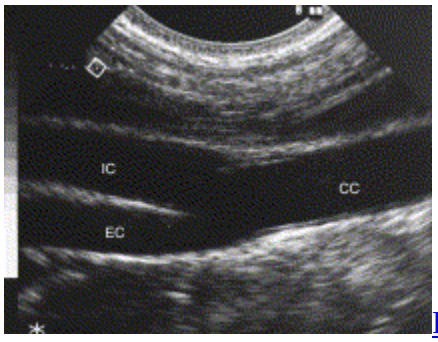
Radiography.

Radiograph of a fractured fibula (**A**) and callus formation 6 weeks later (**B**).

(Courtesy of Barbara Weissman, Brigham's and Women's Hospital, Boston, MA. In Kumar V, et al: *Robbins and Cotran: Pathologic Basis of Disease,* ed 8, St Louis, 2009, Saunders)

Ultrasonography (Echography)

Ultrasonography uses ultrasound (high-frequency sound waves imperceptible to the human ear) to create images of organs and vessels (Figure 5-19).



Full-size image (34K)

Figure 5-19.

Ultrasonography.

Ultrasonographic image of the carotid artery. *CC,* Common carotid artery; *EC,* external carotid artery; *IC,* internal carotid artery.

(From Ryan S, et al: *Anatomy for diagnostic imaging*, ed 2, Edinburgh, 2004, Saunders, Ltd.)

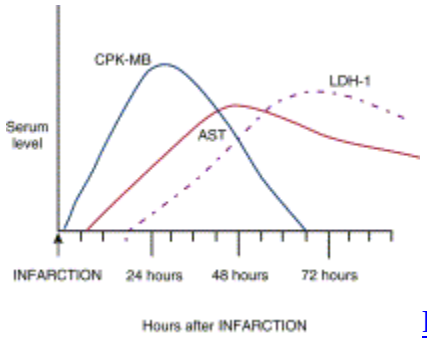
Cardiovascular System

A variety of noninvasive and invasive laboratory and diagnostic tests are used to evaluate and monitor the cardiovascular system. Reference ranges for cardiovascular laboratory tests are listed in Table 5-1.

Laboratory Tests

Cardiac Enzymes

The pattern and time course of the appearance of enzymes in the blood after cardiac muscle cell damage are used to diagnose myocardial infarction (Figure 5-20).



Full-size image (25K)

Figure 5-20.

Myocardial Infarction: Serum Enzyme Levels.

Enzyme and isoenzyme levels after myocardial infarction. *AST,* Aspartate aminotransferase; *CPK-MB,* creatine kinase containing M and B subunits; *LDH-1,* lactate dehydrogenase.

(From Gould BE: *Pathophysiology for the health professions*, ed 3, St Louis, 2006, Saunders.)

Creatinine Kinase

Creatine kinase (CK; creatine phosphokinase) is found in skeletal muscle, cardiac muscle, and the brain, bladder, stomach, and colon. Isoenzyme fractions identify the type of tissue damaged. CK-BB (CK1) is found in the brain, bladder, stomach, and colon; CK-MB (CK2) is found in cardiac tissue; and CK-MM (CK3) is found in skeletal muscle. CK-MB is detectable in the blood within 3 to 5 hours after a myocardial infarction; levels peak at about 10 to 20 hours and normalize within about 3 days.

Cholesterol

Cholesterol is separated into lipoproteins by protein electrophoresis. The level of low-density lipoprotein (LDL) is strongly correlated with coronary artery disease. The level of high-density lipoprotein (HDL) is inversely correlated with coronary artery disease.

C-Reactive Protein

C-reactive protein (CRP) is a biologic marker of systemic inflammation. Preliminary studies have linked an increased CRP concentration to an increased risk of myocardial infarction, stroke, and peripheral arterial disease.

Lactate Dehydrogenase

Lactate dehydrogenase (LDH) is found in a variety of body tissues. Isoenzyme fractions are used to identify the type of tissue damage. LDH_1 and LDH_2 are found in the heart, brain, and erythrocytes. LDH_3 is found in the brain and kidneys. LDH_4 is found in the liver, skeletal muscle, and kidneys. LDH_5 is found in the liver, skeletal muscle, and ileum. LDH_2 normally accounts for the highest percentage of total serum LDH. After a myocardial infarction the rise in LDH_1 concentration exceeds the rise in LDH_2 concentration (the LDH_1/LDH_2 ratio is >1; a "flipped" ratio). LDH increases within about 12 hours after a myocardial infarction, peaks between 24 and 48 hours, and normalizes by about day 10.

Myoglobin

Myoglobin is a small protein found in cardiac and skeletal muscle. The presence of myoglobin in the urine or plasma is a relatively sensitive indicator of cellular damage.

Triglycerides

Triglycerides (TGs) are components of very-low-density lipoproteins (VLDLs) and chylomicrons.

Troponins

Troponins are a complex of proteins (troponin I, C, and T) that mediate the actin and myosin interaction in muscle. Troponins I and T are specific to cardiac muscle and are used to detect cardiac muscle injury. Troponin I and T concentrations increase within a few hours of cardiac muscle injury and remain elevated for 5 to 7 days.

Diagnostic Tests and Procedures

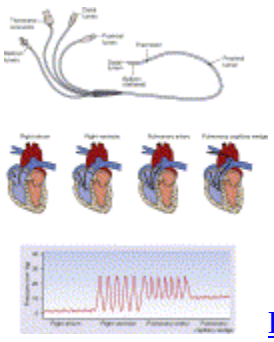
Cardiac Catheterization

Cardiac catheterization is used to evaluate cardiac function. A catheter is passed into the right or left side of the heart. Transducers on the tip of the catheter record pressures in the vessels and chambers of the heart. Ports in the catheter provide access for obtaining blood samples for the determination of oxygen content and cardiac output. Right-sided catheterization is used to measure right atrial pressures, right ventricular pressures, pulmonary artery pressures, and

pulmonary artery occlusion pressure. Left-sided catheterization is used to measure left ventricular pressures.

Central Line Placement with Hemodynamic Monitoring

In hemodynamic monitoring using a central line, a catheter is placed into the central venous system and advanced into the right side of the heart (Figure 5-21). The right atrial, right ventricular, pulmonary artery, and pulmonary artery occlusion (formerly known as *pulmonary capillary wedge*) pressures are measured, and cardiac output is calculated. These parameters are used to monitor the hemodynamic status of the patient and to calculate the pulmonary and peripheral vascular resistances.



Full-size image (50K)

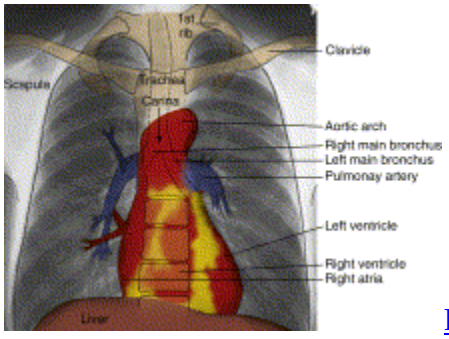
Figure 5-21.

Swan-Ganz Catheterization.

Pulmonary artery catheter, catheter positioned in the heart, and typical waveforms.

Chest Radiography

Chest radiographs are used to diagnose cardiac disease and monitor patient response to drug and nondrug therapy (Figure 5-22). The chest radiograph is used to determine the size and shape of the atria and ventricles, to calculate the cardiothoracic ratio, and to detect abnormalities in the lung fields and pleural spaces.



Full-size image (38K)

Figure 5-22.

Chest Radiography.

Chest radiography is used to assess chest structures.

Coronary Angiography

In coronary angiography the cardiac vessels are visualized by injecting the vessels with a contrast agent.

Digital Subtraction Angiography

In digital subtraction angiography (DSA) background images are obtained before the contrast agent is injected. The background images are then “subtracted” from the images obtained after the injection of the contrast agent. This technique improves image resolution.

Echocardiography

Echocardiography is used to evaluate the size, shape, and motion of the valves, septum, and walls as well as changes in chamber size during the cardiac cycle. The beam is applied to the heart through the chest (transthoracic approach, TTE) or the esophagus (transesophageal approach, TEE).

Contrast echocardiography

Visualization of the right-sided chambers of the heart is enhanced by the injection of contrast agents.

Doppler echocardiography

Doppler imaging and echocardiography techniques are combined to evaluate cardiac blood flow patterns.

Exercise echocardiography

Exercise echocardiography compares echocardiograms obtained before and during exercise.

M-mode echocardiography

M-mode echocardiography records the motion of the heart over time. It is used to evaluate the structures of the heart throughout the cardiac cycle.

Two-dimensional echocardiography

Two-dimensional echocardiography records two-dimensional images of the heart. The spatial anatomic relationships can be determined by changing the angle of the beam.

Electrocardiography

Electrocardiography records cardiac electrical activity.

Electrocardiogram

The electrocardiogram (ECG) records the electrical activity of the heart (Figure 5-23). The ECG is used to diagnose cardiac disease, monitor patient response to drug therapy, and monitor for adverse drug effects. Twelve separate leads, including six extremity (limb) leads (aVR [augmented voltage right arm], aVL [augmented voltage left arm], aVF [augmented voltage left foot], I, II, III) and six chest (precordial) leads (V_1, V_2, V_3, V_4, V_5, V_6), create a three-dimensional view of cardiac electrical activity (Figure 5-24, Figure 5-25 and Figure 5-26).

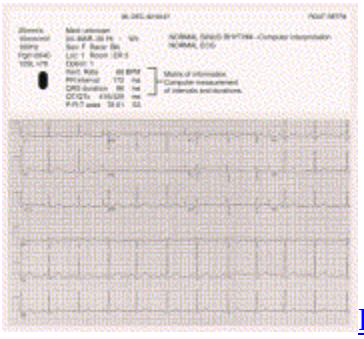

Full-size image (43K)

Figure 5-23.

Twelve-Lead Electrocardiography.

Normal 12-lead electrocardiogram.

(Phalen T: *The 12-lead ECG in acute myocardial infarction,* St Louis, 1996, Mosby.)

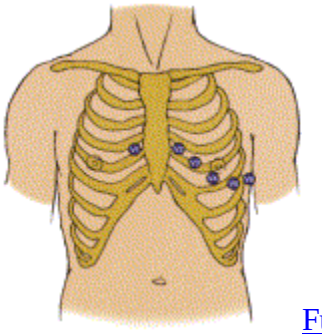
Full-size image (29K)

Figure 5-24.

Electrocardiography.

Placement of electrocardiograph leads.

(From Aehlert B: *ACLS study guide*, ed 3, St Louis, 2007, Mosby.)



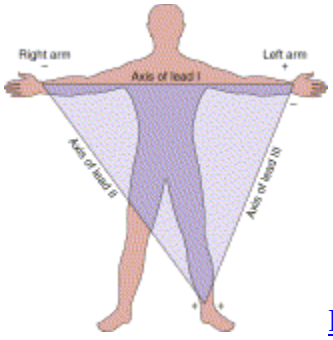
Full-size image (35K)

Figure 5-25.

Electrocardiography.

Placement of chest leads for electrocardiography.

From Aehlert B: *ACLS study guide*, ed 3, St Louis, 2007, Mosby.



Full-size image (24K)

Figure 5-26.

Electrocardiography.

Placement of limb leads for electrocardiography.

(From Aehlert B: *Paramedic's practice today: above and beyond*, St Louis, 2009, Mosby/JEMS.)

Electrocardiogram with stress (stress test)

In the stress test, the ECG is recorded during a standardized exercise protocol with gradually increasing levels of exercise or with the patient at rest after the administration of dobutamine or dipyridamole; either intervention increases myocardial oxygen consumption and blood flow. A

motorized treadmill or cycle ergometer is used for the exercise stress test. Blood pressure, heart rate, oxygen consumption, oxygen saturation, and arterial blood gas data are commonly collected to provide a thorough assessment of how the cardiovascular system functions under stress conditions.

Holter monitoring (ambulatory electrocardiography)

The Holter monitor is a portable recorder used to record the ECG continuously throughout the patient's usual activities.

Thallium stress test

The thallium stress test combines the parenteral administration of thallium Tl 201, a radionuclide taken up by healthy myocardial tissue, and the stress test (either exercise or pharmacologic). A gamma camera is used to record serial images of the myocardium.

Intracardiac Electrophysiologic Studies

Intracardiac electrophysiologic studies (EPSs) are tests in which special catheters with electrodes are used to stimulate the cardiac tissue to assess the nature and origin of cardiac arrhythmias and the response to antiarrhythmic drug therapy.

Lymphoscintigraphy

Lymphoscintigraphy evaluates the patency and anatomy of peripheral lymph vessels by placing a radioactive agent in the tissue drained by the lymph system being evaluated. The test is used to assess lymphedema and tumor involvement or regional lymph nodes that cannot be visualized with other imaging procedures.

Multiple Gated Acquisition Scan

The multiple gated acquisition (MUGA) scan, also known as *radionuclide angiocardiography*, evaluates ventricular function, cardiac wall motion, ejection fraction, and cardiac output after the injection of albumin or red blood cells (RBCs) labeled with a radionuclide (technetium Tc 99m).

Technetium Tc 99m Pyrophosphate Uptake

Infarcted myocardial tissue shows an increased uptake of technetium Tc 99m compared with healthy tissue. The isotope is injected parenterally, and serial images of the heart are obtained to evaluate the location and extent of the myocardial damage.

Endocrine System

The endocrine system consists of the pituitary, hypothalamus, adrenal gland, thyroid gland, parathyroid glands, and pancreas. The endocrine system is assessed by measuring the levels of the hormones produced by the different components of the system. Therapeutic response to replacement or suppressive drug therapy also is assessed by measuring the levels of these

hormones. A variety of specific tests are used to assess each component of the endocrine system. Reference ranges for endocrine system laboratory tests are listed in Table 5-2.

Laboratory Tests

Adrenal Tests

Adrenal medulla

The adrenal medulla secretes catecholamines. The 24-hour urinary excretion of epinephrine, norepinephrine, and vanillylmandelic acid (VMA) is used to assess the function of the adrenal medulla.

Adrenal cortex

The adrenal cortex secretes mineralocorticoids, glucocorticoids, and androgens. Tests used to assess the function of the adrenal cortex include plasma and urine aldosterone; plasma renin activity; serum testosterone; serum estradiol; plasma cortisol (morning and evening); plasma adrenocorticotropic hormone (ACTH) (morning); and urinary excretion rates for 17-hydroxycorticosteroids, 17-ketogenic steroids, and 17-ketosteroids.

Dexamethasone suppression test

Dexamethasone suppresses ACTH secretion. A baseline 8 AM plasma cortisol level is obtained and then 1 mg of dexamethasone is administered orally at 11 PM. Normally, cortisol production is suppressed, and the 8 AM plasma cortisol level obtained the next day is low.

Insulin tolerance test

In the insulin tolerance test, insulin (0.05 to 0.1 units/kg) is administered intravenously. Serial blood samples are obtained for 90 minutes. ACTH is released when the blood glucose level falls to less than 40 mg/dL.

Metyrapone test

Metyrapone inhibits the final step in cortisol synthesis. For the metyrapone test, 500 to 750 mg of metyrapone is administered orally every 4 hours for 24 hours, and plasma samples are collected. A normal response is a decrease in plasma cortisol and an elevation in urine and plasma 11-deoxycortisol (compound S).

Pancreatic Tests

Amylase

Amylase is secreted by the pancreas, bowel, parotids, and gynecologic system. Although not specific for pancreatitis, serum amylase is easier to measure than is lipase and is used as a common screening and monitoring parameter for acute pancreatitis. In chronic pancreatitis, however, the pancreas may be burned out and unable to secrete amylase.

C peptide

C peptide is an inactive peptide chain released from beta cells in equimolar amounts with insulin and is found in the serum in about a 5:1 to 15:1 ratio with insulin. C peptide level is sometimes used to assess pancreatic function.

Glucose

Serum glucose concentrations are used to assess pancreatic function and the response to insulin replacement therapy.

Fasting serum glucose

For the fasting serum glucose test the serum sample is obtained after 10 to 14 hours of fasting. The fasting serum glucose level is usually obtained before breakfast after an overnight fast.

Glucose tolerance test

The glucose tolerance test (GTT) is used to diagnose diabetes mellitus and gestational diabetes. Patients fast for 10 to 16 hours before the test and are then given approximately 75 g of glucose. Serial blood samples are obtained, and the serum glucose concentration is determined. Normally, the serum blood glucose level is less than 200 mg/dL at 30, 60, and 90 minutes and less than 140 mg/dL at 2 hours.

Random serum glucose

The random serum glucose sample can be obtained at any time without fasting.

Glycosylated hemoglobin

Glycosylated hemoglobin is formed when hemoglobin is irreversibly glycosylated after exposure to high glucose levels. Glycosylated hemoglobin levels assess long-term control of hyperglycemia with insulin therapy and differentiate factitious hyperglycemia from diabetes.

Insulin

Fasting serum insulin level is sometimes measured during the assessment of pancreatic function.

Lipase

Lipase is a specific marker for acute pancreatic disease. Increases in serum lipase parallel increases in serum amylase. In chronic pancreatitis, however, the pancreas may be burned out and unable to secrete lipase.

Parathyroid Tests

The parathyroid gland secretes parathyroid hormone (PTH). High serum calcium levels suppress PTH secretion. Parathyroid gland function is tested by measuring the serum concentrations of

PTH, calcium, and phosphorus. The serum concentration of PTH is useful in differentiating between hypercalcemia resulting from hyperparathyroidism and hypercalcemia resulting from other causes.

Pituitary Tests

Anterior pituitary

The anterior pituitary hormones include growth hormone, prolactin, thyroid-stimulating hormone (TSH), follicle-stimulating hormone, luteinizing hormone, and ACTH. Pituitary function is assessed by measuring the concentrations of the hormones at baseline and after stimulation or suppression.

Adrenocorticotropic hormone stimulation test

ACTH stimulates adrenal cortisol production. A baseline plasma cortisol level is obtained and then 250 mcg of cosyntropin is injected intravenously. Normally, plasma cortisol levels peak in 30 to 60 minutes.

Posterior pituitary

The posterior pituitary hormones include antidiuretic hormone (ADH) and oxytocin. Tests used to evaluate posterior pituitary function include concentration testing and water loading. Concentration testing involves overnight water deprivation and evaluation of urine and serum osmolality. Water loading involves the administration of 1000 mL of water and then evaluation of urine and serum osmolality.

Thyroid Tests

Thyroid function tests are used to establish the level of thyroid function (e.g., hyperthyroid, hypothyroid, euthyroid) and the response to suppressant or replacement therapy. Thyroid function is assessed by evaluating the serum concentrations of the free hormones thyroxine (T_4) and triiodothyronine (T_3) and by a number of indirect methods.

Free thyroxine index

The free thyroxine index (FT_4I) is the product of the measured T_4 level and the triiodothyronine uptake (T_3U). It takes into account the absolute hormone level and the binding capacity of thyroid-binding globulin. The FT_4I is decreased in hypothyroidism and increased in hyperthyroidism.

Thyroid-stimulating hormone (thyrotropin)

Serum levels of TSH, or thyrotropin, are used to differentiate between thyroid-related hypothyroidism and pituitary-related hypothyroidism. The TSH level is elevated in thyroidal hypothyroidism and markedly decreased in pituitary hypothyroidism.

Thyroid uptake of radioiodine

Radioactive iodine (iodine I 123 or iodine I 131) is administered orally, and the radioactivity over the thyroid gland is measured at various intervals. The normal radioactive iodine uptake (RAIU) is about 10% to 35%.

Thyrotropin-releasing hormone

Thyrotropin-releasing hormone (TRH) stimulates the pituitary to release TSH. Injection of synthetic TRH normally causes an increase in TSH in about 30 minutes.

Triiodothyronine uptake

The T_3U test is an in vitro test that indirectly estimates the amount of thyroid-binding globulin in the serum.

Gastrointestinal System

A variety of noninvasive and invasive laboratory and diagnostic tests are used to evaluate and monitor the gastrointestinal system. Reference ranges for gastrointestinal laboratory tests are listed in Table 5-3.

Laboratory Tests

Biliary System

Bilirubin is useful in the diagnosis and monitoring of liver disease and hemolytic anemia and in the assessment of the severity of jaundice. A patient is generally visibly jaundiced if the bilirubin level is higher than 2 mg/dL.

Alkaline phosphatase

Alkaline phosphatase level is elevated in biliary cirrhosis, cirrhosis, and intrahepatic bile duct disease.

Direct bilirubin

Direct bilirubin is water-soluble conjugated posthepatic bilirubin. It is increased in biliary disease (e.g., extrahepatic bile duct obstruction, physical impairment of bile flow, impaired bile transport) and some liver disease (e.g., hepatitis, cirrhosis, hepatic neoplasm).

Delta bilirubin

Delta bilirubin is albumin-bound conjugated bilirubin. The level of delta bilirubin is a calculated value ([delta bilirubin = total bilirubin – (unconjugated bilirubin + conjugated bilirubin)]. Delta bilirubin is metabolically inactive and is cleared slowly from the body. Its level is increased in biliary obstruction and some liver disease.

Indirect bilirubin

Indirect bilirubin is unconjugated bilirubin. Its level is increased in hemolytic anemia (rapid, severe hemolysis) and some liver disease.

Total bilirubin

Total bilirubin is the sum of all three forms of bilirubin (direct bilirubin, indirect bilirubin, and delta bilirubin). Total bilirubin is increased in hepatic and hemolytic diseases.

Hepatic Synthetic Function

Many drugs are metabolized hepatically. One way of assessing the liver's ability to metabolize these agents is to assess the synthetic function of the liver by evaluating the quantity of specific products produced or processed by the liver. These include ammonia, albumin, and the vitamin K–dependent clotting factors.

Ammonia

The liver synthesizes urea from ammonia. Serum ammonia level is increased if the liver is damaged or if blood flow is compromised. Although serum ammonia level is not used as a routine screening test, it is sometimes performed to confirm a diagnosis of hepatic encephalopathy.

Protein production

The liver manufactures many different proteins. The serum levels of albumin and the vitamin K–dependent clotting factors are commonly used to assess hepatic synthetic function.

Albumin

Although circulating albumin takes several weeks to clear from the body, a rapidly declining serum protein level indicates greatly impaired hepatic synthetic function. Longstanding liver disease is associated with very low serum protein concentrations.

Vitamin K–dependent clotting factors (factors II, VII, IX, and X)

Lack of production of the vitamin K–dependent clotting factors prolongs the prothrombin time (PT) and activated partial thromboplastin time (aPTT). The PT is prolonged earlier than the aPTT and often is used as an early indicator of impaired hepatic synthetic function. Both the PT and aPTT are prolonged in longstanding severe hepatic dysfunction.

Hepatocellular Enzymes

Hepatocytes contain numerous enzymes that leak into the serum when liver cells die or are damaged.

Elevations of these enzymes occur in the presence of marked changes in hepatic circulation (e.g., cardiovascular shock) and diseases associated with hepatocellular damage (hepatitis, cirrhosis,

inflammatory disease, and infiltrative hepatic diseases). However, serum enzyme levels may not be markedly elevated in severe, chronic, end-stage liver disease (because the liver is burned out). Very high elevations (more than 20 times the normal level) are associated with viral or toxic hepatitis. Moderately high elevations (3 to 10 times normal) are associated with infectious mononucleosis, chronic active hepatitis, extrahepatic bile duct obstruction, and intrahepatic cholestasis. Modest elevations (one to three times normal) are associated with pancreatitis, alcoholic fatty liver, biliary cirrhosis, and neoplastic infiltration.

Alanine aminotransferase

Alanine aminotransferase (ALT) is found in high concentrations in hepatocytes and is considered a specific marker of hepatocellular damage.

Aspartate aminotransferase

Aspartate aminotransferase (AST) is found in hepatocytes, myocardial muscles, skeletal muscle, the brain, and the kidneys. It is used as a nonspecific marker of hepatocellular damage.

Gamma glutamyl transpeptidase

Gamma glutamyl transpeptidase (GGT) is found in hepatobiliary, pancreatic, and kidney cells. It is elevated in most hepatocellular and hepatobiliary disease, although elevations correlate better with obstructive disease than with pure hepatocellular damage. An elevated GGT level is an early indicator of alcoholic liver disease.

Lactate dehydrogenase

LDH is found in the heart, brain, erythrocytes, kidneys, liver, skeletal muscle, and ileum. Elevations occur during shock syndrome (marked changes in circulation) and in diseases associated with hepatocellular damage (hepatitis, cirrhosis, inflammatory disease, and infiltrative disease).

Stool

The stool is evaluated for color, consistency, and the presence of obvious or occult blood, fat, ova and parasites, microorganisms, and white blood cells (WBCs). The color of the stool provides important diagnostic and monitoring information. Black stools may indicate upper gastrointestinal tract bleeding; however, iron therapy may produce a similar color. Gray stools are generally associated with steatorrhea; light gray stools may indicate bile duct obstruction. Watery stools are indicative of rapid gastrointestinal tract transit and malabsorption syndromes. Hard stools may indicate dehydration. The presence of obvious blood in the stool indicates colonic bleeding. Occult blood, present in both upper and lower gastrointestinal tract bleeding, may be detected for several weeks after gastrointestinal tract bleeding. Stool fat is increased in diseases associated with altered bacterial flora, increased gastrointestinal tract motility, decreased enzyme and bile acid content, and loss of absorptive surfaces. The presence of WBCs is associated with a variety of infectious processes and inflammatory bowel disease.

Miscellaneous

Alpha fetoprotein

Alpha fetoprotein is the major protein produced by the fetus in the first 10 weeks of life. It also is produced by rapidly multiplying hepatocytes and is used as a marker of hepatocellular carcinoma.

Carcinoembryonic antigen

Carcinoembryonic antigen (CEA) is a tumor marker found in the blood. It is associated with rapid multiplication of digestive system epithelial cells and is used to monitor tumor recurrence.

Diagnostic Tests and Procedures

Abdominal Radiography

The abdominal radiograph, including the kidneys, ureter, and bladder (KUB), is obtained with the patient lying supine and is used to identify intestinal obstruction and other organ-specific structural abnormalities.

Ascitic Fluid Analysis

Abdominal paracentesis is used to obtain ascitic fluid for analysis. The fluid is assessed for each of the following characteristics.[3]

Color

Ascitic fluid may be yellow in cirrhosis, cloudy in infection, brown in hyperbilirubinemia, or bloody in malignancy or after a traumatic tap.

Cell count

A polymorphonuclear cell count of 250/mm^3 or more indicates infection.

Serum/ascites albumin gradient

A serum/ascites albumin gradient of 1.1 g/dL or higher indicates portal hypertension.

Other laboratory tests

Other laboratory tests include total protein, glucose, LDH, amylase, triglycerides, and bilirubin. The fluid may be examined for the presence of abnormal cells and may be tested with fungal and Gram stains or cultured.

Barium Studies

In barium studies the patient swallows contrast material, such as barium sulfate, and radiographs are taken to visualize the esophagus, stomach, and small intestine. Barium enemas are used to visualize the large intestine. The double-contrast barium enema technique uses a combination of barium and air to visualize the large intestine and is considered a more precise procedure (Figure 5-27).

Full-size image (36K)

Figure 5-27.

Barium Enema Study.

Image obtained using the double-contrast barium enema technique. *1*, Cecum; *2*, ascending colon; *3*, hepatic flexure; *4*, mid-transverse colon; *5*, splenic flexure; *6*, descending colon; *7*, sigmoid colon; *8*, rectum; *white arrow*, terminal ileum; *open arrow*, appendix.

(From Pretorius E, Solomon J: *Radiology secrets*, ed 2, Philadelphia, 2006, Mosby.)

Capsule Endoscopy

Capsule endoscopy is a relatively new method used to visualize the gastrointestinal tract. The patient swallows a disposable capsule about the size of a large vitamin tablet that contains a miniature video camera, a light source, a miniature transmitter, antenna, and battery. Images are transmitted to an external receiver in a belt worn around the patient's waist. Peristalsis moves the capsule through the gastrointestinal tract; the capsule is excreted rectally.

Cholecystography

Cholecystography is used to evaluate gallbladder function and anatomy. Orally administered iopanoic acid concentrates in the gallbladder, opacifying it for visualization.

Cholecystosonography

Sonography is used to detect gallstones and evaluate the gallbladder, biliary system, and adjacent organs. Sonography has nearly replaced cholecystography.

Colonoscopy

In colonoscopy a flexible fiberoptic tube is inserted rectally to visualize the lining of the large intestine from the rectum through the colon to the lower end of the small intestine.

D-Xylose Test

The D-xylose test is used to screen for carbohydrate malabsorption. For this test a dose of 25 g of D-xylose is administered with water, and the urine is collected for a 5-hour period. Normally, more than 3 g of D-xylose is excreted in the urine during this period; lower amounts indicate impaired carbohydrate absorption.

Endoscopic Retrograde Cholangiopancreatography

Endoscopic retrograde cholangiopancreatography (ERCP) combines endoscopy and radiography to visualize the biliary system and pancreas. An endoscope is inserted in the esophagus and advanced to the point where the bile duct and pancreatic duct open in the duodenum; contrast dye is injected into the ducts. Radiography is performed to visualize the ducts.

Endoscopy

In endoscopy a flexible fiberoptic tube is inserted orally into the esophagus to visualize the lining of the upper and lower gastrointestinal tract.

Esophagogastroduodenoscopy

In esophagogastroduodenoscopy (EGD) an endoscope is inserted into the esophagus to visualize the lining of the esophagus, stomach, and duodenum. Biopsy specimens and fluid for culture and cytologic analysis may be obtained. Interventions such as polypectomy and vessel obliteration may be performed.

Intragastric pH

The pH of gastric secretions is sometimes measured to monitor the effectiveness of acid-suppressive drug therapy or to document the presence and severity of acid reflux.

Manometry

Manometry is used to evaluate esophageal contractions and esophageal sphincter pressures. Pressures are measured by pressure transducers on a tube inserted orally.

Percutaneous Transhepatic Cholangiography

In percutaneous transhepatic cholangiography, a contrast medium is injected directly into the biliary radicle within the liver, and fluoroscopy is used to visualize the intrahepatic and extrahepatic bile ducts.

pH Stimulation Tests

Tests involving pH stimulation are used to determine the response of gastric acid secretion to a chemical stimulus; they are sometimes used to diagnose hyposecretory and hypersecretory gastric acid disorders. Gastric secretions are collected from the stomach by aspiration through a nasogastric tube. Secretions are collected at baseline and after stimulation with betazole or pentagastrin.

Schilling Test

The Schilling test is used to evaluate the absorption of vitamin B_{12} (cyanocobalamin). In the first part of the test, 1000 mcg of regular B_{12} is administered parenterally to saturate the systemic vitamin B_{12} storage sites. A 0.5 to 1 mcg dose of vitamin B_{12} labeled with cobalt Co 57 is then administered orally, and urine is collected. Normally, more than 7% of the radiolabeled vitamin B_{12} is excreted in the urine in a 24-hour period. If indicated, the test may be repeated with the administration of 60 mcg of oral intrinsic factor. If the malabsorption of vitamin B_{12} is caused by a deficiency of intrinsic factor, the amount of radiolabeled B_{12} excreted in the urine rises to normal levels.

Sigmoidoscopy

In sigmoidoscopy an endoscope is used to evaluate the gastrointestinal tract from the anus to about 60 cm into the terminal colon. The rigid sigmoidoscope is used to screen for rectosigmoid cancer, to obtain biopsy specimens, and to evaluate patients with inflammatory disease of the rectum or distal sigmoid colon. The flexible sigmoidoscope is longer and more useful in the assessment of the sigmoid colon.

Hematologic System

Blood consists of plasma and cells suspended in the plasma. The plasma is composed of water and dissolved proteins, electrolytes, and organic and inorganic substances. Blood cells include erythrocytes (RBCs), leukocytes (WBCs), and platelets (Figure 5-28). A variety of noninvasive and invasive laboratory and diagnostic tests are used to evaluate and monitor the hematologic system. Reference ranges for hematology laboratory tests are listed in Table 5-4.

Full-size image (22K)

Figure 5-28.

Cell Line Relationships.

General Laboratory Tests

ABO Blood Typing

The antigenic properties of blood are analyzed to avoid potentially lethal transfusion reactions. Blood types include A, B, AB, and O.

Blood Smear

The blood smear is produced by spreading a drop of peripheral blood on a slide and examining the smear microscopically. The blood smear is used to obtain a WBC count and differential, to estimate the platelet count, and to evaluate RBC morphology (Figure 5-29).

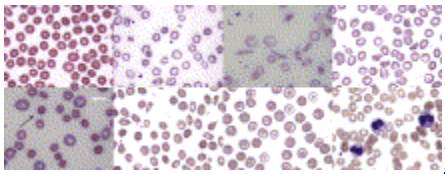

Full-size image (92K)

Figure 5-29.

Peripheral Blood Smears.

(From Andreoli T, et al: *Andreoli and Carpenter's Cecil Essentials of Medicine*, Philadelphia, 2007, Saunders.)

Coagulation Tests

The common tests of coagulation include the bleeding time, aPTT, PT, and thrombin time.

Bleeding time

The bleeding time is the duration of bleeding after a standardized skin incision is made. It is used to evaluate platelet quantity and function.

Partial thromboplastin time, activated

The aPTT assesses the intrinsic clotting pathway (i.e., factors II, V, VIII, IX, X, XI, and XII). It is commonly used to monitor heparin therapy.

Prothrombin time

The PT is used to assess the extrinsic and common clotting pathways (i.e., factors II, V, VII, and X and fibrinogen). It is used to monitor warfarin therapy and to assess hepatic synthetic function. The international normalized ratio (INR) is a standardized expression of PT that takes into account differences in reagent activity. It is calculated according to the equation $INR = (PT_{patient} \div PT_{control})^{ISI}$, where *ISI* is the international sensitivity index. The INR allows for more accurate

comparisons among clotting times measured using different reagents (e.g., in different laboratories).

Thrombin time

The thrombin time is used to evaluate the effect of heparin and thrombolytic drug therapy and coagulation abnormalities.

Complete Blood Count

The complete blood count (CBC) consists of the hemoglobin, hematocrit, RBC count, WBC count, mean cell volume, mean corpuscular hemoglobin, and mean corpuscular hemoglobin concentration.

Crossmatching

Crossmatching determines compatibility between donor and recipient blood. Agglutination between the donor's RBCs and the recipient's serum indicates incompatibility.

Fibrinogen

Fibrinogen is increased in disseminated intravascular coagulation. It is used to evaluate bleeding disorders.

Fibrin Degradation Products

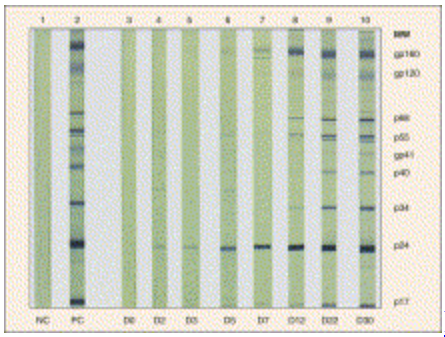
Fibrin degradation products (FDPs) are released when fibrin is broken down. They are assessed in the diagnosis and monitoring of disseminated intravascular coagulation.

Hemoglobin Electrophoresis

Immunoelectrophoresis uses electrophoretic separation and immunodiffusion to screen for the presence of abnormal proteins such as Bence Jones and myeloma proteins.

Serum Electrophoresis

Serum protein electrophoresis (SPEP) is used to screen for serum protein abnormalities. The proteins albumin, alpha$_1$ globulin, alpha$_2$ globulin, beta globulin, and gamma globulin are identified by different migration patterns when subjected to an electric field. Human immunodeficiency virus (HIV) protein antigens are separated by electrophoresis (Figure 5-30).



Full-size image (60K)

Figure 5-30.

Electrophoresis.

Human immunodeficiency virus (HIV) protein antigens separated by electrophoresis and blotted onto paper strips demonstrating seroconversion in one HIV-infected person. *D0-D30,* Day 0 to day 30; *NC,* negative control; *PC,* positive control.

(From Boucher, C: *Retroviruses and retroviral infections. In Cohen J: Powderly WG: Infections diseases,* ed 3, St Louis, 2010, Mosby.)

Laboratory Tests by Specific Cell Type

Platelets

Platelets initiate hemostasis. The risk of spontaneous bleeding is greatly increased if the platelet count is lower than 20,000 cells/mm^3. The platelet count is sometimes estimated from the peripheral blood smear; the count is considered adequate if the smear contains two to three platelets per field. A formal count may be performed manually or electronically and is a more accurate estimate of the number of platelets.

The platelet count and platelet function are altered in a variety of diseases. The platelet count is decreased if the bone marrow fails to produce platelets (as in aplastic anemia, leukemia, and some viral infections) or there is peripheral platelet destruction (as in idiopathic thrombocytopenic purpura, disseminated intravascular coagulation, and hemolytic uremic syndrome). The platelet count may be increased after splenectomy; in some myeloproliferative diseases, such as myelogenous leukemia and essential thrombocythemia; and in chronic inflammatory disease, malignancy, and chronic infections. Platelet function is impaired by drugs such as aspirin, dipyridamole, and nonsteroidal antiinflammatory drugs and by disease states such as uremia, multiple myeloma, and severe liver disease.

Red Blood Cells

Carboxyhemoglobin.

Carboxyhemoglobin forms in the presence of carbon monoxide (e.g., house fires, automobile exhaust). Carbon monoxide attaches to hemoglobin, rendering the hemoglobin incapable of carrying oxygen.

Coombs' test

Coombs' test is performed using an antiserum containing antibodies that bridge antibody- or complement-coated RBCs. Agglutination (clumping) occurs when the cells are bridged.

Direct Coombs' test

The direct Coombs' test uses antibodies directed against human proteins (primarily immunoglobulin G [IgG] and complement [C3]) to detect whether these proteins are attached to the surface of RBCs. The direct Coombs' test is used to differentiate between immunologic (e.g., autoimmune) and nonimmunologic (e.g., drug-induced) hemolytic anemias.

Indirect Coombs' test

The indirect Coombs' test detects antibodies against human RBCs in the patient's serum. The indirect Coombs' test is used in crossmatching before blood transfusions.

Erythrocyte sedimentation rate

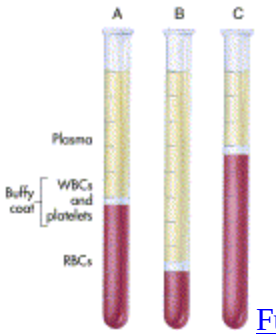
The erythrocyte sedimentation rate (ESR) measures the rate at which RBCs settle out of mixed venous blood. The settling rate, influenced by the shape of the RBC and membrane charges, is used as a nonspecific marker of inflammatory and malignant disease.

Folate

Decreased serum folate levels are associated with megaloblastic anemias.

Hematocrit

The hematocrit is the percentage of the volume of blood occupied by RBCs (Figure 5-31). Reference ranges vary with age, gender, and elevation above sea level. The hematocrit is increased in vitamin B_{12} and folic acid deficiencies and is decreased in iron deficiency. The hematocrit is used to diagnose anemia and assess patient response to replacement therapy.



Full-size image (22K)

Figure 5-31.

Hematocrit.

A, Normal percentage of red blood cells (RBCs). **B,** Anemia (low percentage of RBCs). **C,** Polycythemia (high percentage of RBCs). *WBCs,* White blood cells.

(From Thibodeau GA, Patton KT: *Anatomy and physiology*, ed 5, St Louis, 2003, Mosby.)

Hemoglobin

Hemoglobin is the oxygen-carrying RBC protein. Reference ranges vary with age, gender, and elevation above sea level. Hemoglobin is decreased in blood loss and iron deficiency anemia. Hemoglobin is used to diagnose anemia, assess patient response to replacement therapy, and estimate arterial and venous oxygen content (milliliter of oxygen per deciliter of blood).

Iron metabolism

Ferritin

Serum ferritin is in equilibrium with tissue ferritin, which makes it a useful indicator of tissue iron stores. It is used to diagnose iron deficiency anemia.

Iron

Serum iron levels are decreased in iron deficiency anemia, chronic infections, and some malignancies. Serum iron levels may be increased in iron poisoning and hemolysis.

Total iron-binding capacity

The total iron-binding capacity (TIBC) test evaluates the capacity of transferrin to bind to iron. It is used to diagnose iron deficiency anemia and to monitor replacement therapy.

Transferrin saturation

Transferrin is a specific iron transport protein. The transferrin saturation test evaluates the percentage of total iron-binding protein saturated with iron. It is used to diagnose iron deficiency anemia and to monitor replacement therapy.

Red blood cell appearance

The size, shape, and color of RBCs are influenced by many diseases. A variety of terms are used to describe the RBC appearance:

Acanthocytes

Acanthocytes, RBCs with long, thin, irregularly placed spines on the membrane, are associated with alcoholic cirrhosis and heparin therapy and may appear after splenectomy.

Anisocytosis

Anisocytosis, or variably sized RBCs, is associated with early iron replacement therapy.

Burr cells

Burr cells, RBCs with evenly distributed spicules on the membrane, are associated with uremia.

Elliptocytes

Elliptocytes, rod-shaped RBCs, are associated with sickle cell trait and thalassemia.

Hypochromia

Hypochromia is a decrease in the hemoglobin content of the RBCs. It produces pale RBCs and is associated with folic acid and vitamin B_{12} deficiency anemias.

Macrocytes

Macrocytes are larger-than-normal RBCs.

Microcytes

Microcytes are smaller-than-normal RBCs.

Normochromia

Normochromia describes normal RBC color.

Normocytes

Normocytes are normal-sized RBCs.

Ovalocytes

Ovalocytes, oval-shaped RBCs, are associated with microcytic and megaloblastic anemias.

Schistocytes

Schistocytes, RBC fragments, are associated with disseminated intravascular coagulation, prosthetic heart valves, uremia, and sickle cell anemia.

Spherocytes

Spherocytes, small round RBCs, are associated with anemias and hemolytic transfusion reactions.

Stomatocytes

Stomatocytes, RBCs with central slit-like areas of pallor, are associated with neoplastic, liver, and cardiac disease.

Target cells

Target cells, RBCs with dark centers surrounded by light rings, are associated with sickle cell anemia, iron deficiency, and liver disease; they also may occur after splenectomy.

Red blood cell count

The RBC count is the number of RBCs per cubic millimeter (1 mL) of blood. It is used to diagnose anemia and to assess patient response to replacement therapy. Low counts also serve as an indicator of chronic hypoxemia.

Red blood cell inclusions

RBCs may contain abnormal material, known as *inclusions.*

Basophilic stippling

Basophilic stippling is fine stippling associated with lead poisoning and some anemias.

Heinz bodies

Heinz bodies, masses of denatured hemoglobin, are associated with severe oxidative stress and thalassemia.

Howell-Jolly bodies

Howell-Jolly bodies, fragments of nuclear deoxyribonucleic acid (DNA) that appear as dark purple dots, may occur after splenectomy and also are associated with hemolytic and megaloblastic anemia.

Nucleated red blood cells

Nucleated RBCs, less mature RBCs that still contain nuclei, are associated with intense marrow erythropoietic activity.

Red blood cell indices

The RBC indices consist of the mean cell volume (MCV), mean cell hemoglobin (MCH), and mean cell hemoglobin concentration (MCHC). These indices are used to differentiate the type of anemia and to assess patient response to replacement drug therapy.

Mean corpuscular hemoglobin

MCH is the average RBC hemoglobin content. MCH is decreased in iron deficiency anemia and increased in folic acid and vitamin B_{12} deficiencies and hemolytic anemia.

Mean corpuscular hemoglobin concentration

MCHC is the amount of hemoglobin per volume of RBCs.

Mean cell volume

MCV is the average volume of individual RBCs. MCV is decreased in iron deficiency anemia, thalassemia, and other chronic diseases (e.g., microcytic anemia). It is increased in folic acid and vitamin B_{12} deficiencies (e.g., macrocytic anemia).

Red cell distribution width

The red cell distribution width (RDW) is determined from a histogram of the distribution of RBC volumes as measured with automated equipment. It is used to diagnose anemia and to assess patient response to replacement therapy.

Reticulocytes

Reticulocytes are immature RBCs that contain residual ribonucleic acid (RNA) and protoporphyrin but no nucleus. The reticulocyte count is used to assess the response of the bone marrow to blood loss, hemolysis, and replacement therapy for the treatment of anemia. Healthy marrow produces and releases reticulocytes in response to the need for increased oxygen-carrying capacity.

Vitamin B_{12}

Decreased serum vitamin B_{12} levels are associated with megaloblastic anemia.

White Blood Cells

The three morphologically distinct types of WBCs include granulocytes (basophils, eosinophils, and neutrophils), lymphocytes, and monocytes. The WBC count and differential (the relative percentage and absolute numbers of each type of WBC) are used to diagnose a variety of diseases and to assess patient response to drug therapy.

Granulocytes

Basophils

Basophils produce heparin and have a role similar to that of mast cells in immediate hypersensitivity reactions. Basophils have insignificant phagocytic properties and do not increase in number as a result of infectious processes. The number of basophils may increase in chronic hypersensitivity states, systemic mast cell disease, and myeloproliferative diseases.

Eosinophils

Eosinophils are WBCs that contain numerous inflammatory mediators. The number of eosinophils is increased in parasitic infections and allergic reactions. Some neoplastic diseases, skin disorders, and collagen vascular diseases also may lead to increased numbers of circulating eosinophils.

Neutrophils

Polymorphonuclear cells are mature WBCs. Their precursors, in order of increasing maturity, are myeloblasts, promyelocytes, myelocytes, metamyelocytes, and band neutrophils. A shift to the left in the differential WBC count means that significant numbers of neutrophil precursors, such as bands, are present. Neutrophils are phagocytic cells that engulf and destroy bacteria. The number of neutrophils is increased in infections, tissue necrosis, inflammatory diseases, metabolic disorders, and some leukemias. The number of circulating neutrophils is increased by corticosteroids, exercise, and epinephrine, all of which induce the release of neutrophils from peripheral storage sites. The number of neutrophils is decreased in overwhelming infection and in some bacterial, viral, and protozoal infections. Marrow depressants, liver disease, and some collagen vascular diseases are associated with decreased numbers of neutrophils.

Lymphocytes

Lymphocytes, WBCs formed in lymphoid tissue throughout the body, provide humoral, cell-mediated, and cytotoxic immune responses and interact with antigens in the body. T lymphocytes, derived from the thymus, are responsible for cell-mediated immunity; B lymphocytes, derived from the bone marrow, are responsible for humoral immunity and produce antibodies. Null lymphocytes have neither T-cell nor B-cell characteristics. The lymphocyte count is increased in viral disease, bacterial diseases such as whooping cough, metabolic diseases, and chronic inflammatory conditions. The lymphocyte count is decreased in immunodeficiency syndromes, severe illnesses, and diseases associated with abnormalities of the lymphatic circulatory system.

T lymphocytes are categorized as either CD4-positive or CD8-positive cells. CD4-positive T cells are further characterized as helper T cells types 1, 2, and 17 (Th1, Th2, Th17) and induced regulatory (iTreg) cells. Th1 cells defend against intracellular pathogens and play a role in autoimmunity. Th2 cells defend against extracellular parasites and play a role in allergy and asthma. Th17 cells defend against extracellular bacteria and fungi and play a role in autoimmunity. iTreg cells are involved in immune tolerance, lymphocyte homeostasis, and

regulation of immune responses. CD4-positive T lymphocytes are profoundly decreased in acquired immunodeficiency syndrome (AIDS). CD8-positive T lymphocytes may be increased in hepatitis B, acute mononucleosis, and cytomegaloviral infection. The CD4/CD8 lymphocyte ratio reverses in diseases associated with altered immunoregulatory function.

Monocytes

Monocytes, which are macrophage precursors, circulate briefly before entering body tissues, where they become macrophages. The monocyte count is increased in some infectious, granulomatous, and collagen vascular diseases.

Diagnostic Procedure

Bone Marrow Aspiration

Bone marrow is obtained by penetrating the iliac crest or sternum with a large-bore needle and withdrawing a sample of the bone marrow. The sample is smeared on a slide and evaluated microscopically for cell-line precursors and iron stores. Bone marrow aspirates are used to diagnose anemia and leukemia.

Immunologic System

A variety of laboratory tests and procedures are used to evaluate and monitor the immunologic system. Reference ranges for immunologic laboratory tests are listed in Table 5-5.

Laboratory Tests

Autoantibodies

Autoantibody testing is used in the monitoring and diagnosis of a variety of autoimmune diseases.

Antineutrophil cytoplasmic antibodies

Antineutrophil cytoplasmic antibodies (ANCAs) are autoantibodies against neutrophil granules and monocyte lysosomes. Perinuclear antineutrophil cytoplasmic antibody (p-ANCA) reactivity is associated with angiitis, rheumatoid arthritis, inflammatory bowel disease, and vasculitis. Cytoplasmic antineutrophil cytoplasmic antibody (c-ANCA) reactivity is associated with Wegener’s granulomatosis.

Antinuclear antibodies

Antinuclear antibodies (ANAs) often are associated with systemic lupus erythematosus (SLE), although they may be present in rheumatoid collagen disease, mixed connective tissue disease, and systemic sclerosis. ANA values are reported as a titer and a pattern of cellular fluorescence. The patterns include the following:

- • Homogenous—diffuse fluorescence throughout the nucleus
- • Ring—nuclear border fluorescence
- • Speckled—speckled fluorescence throughout the nucleus
- • Nucleolar—fluorescence in the nucleolar area of the nucleus

Anti-DNA antibodies

Anti-DNA antibodies are antibodies against double-stranded DNA (dsDNA) and single-stranded DNA (ssDNA). Anti-dsDNA antibodies often are found in patients with SLE.

Extractable nuclear antigens

Antibodies may be present against specific extractable nuclear antigens (ENAs). These antigens include the Smith (Sm), ribonucleic protein (RNP), Ro (single-strand A, SSA), La (single-strand B, SSB), Scleroderma-70 (Scl-70), and histone antigens. SLE is associated with high titers of anti–SS-A and anti–SS-B antibodies. Antibodies against histones may be found in patients with drug-induced SLE. Considerable overlap occurs among the diseases associated with these antibodies.

Rheumatoid factors

Antibodies against IgM, IgG, and sometimes IgA (rheumatoid factors, or RFs) may be found in patients with rheumatoid arthritis.

Cold Agglutinins

Cold agglutinins are antibodies that bind to the surface of RBCs; agglutination (clumping) occurs when the blood sample is cooled (Figure 5-32). Cold agglutinins are associated with a variety of infections and inflammatory disorders.

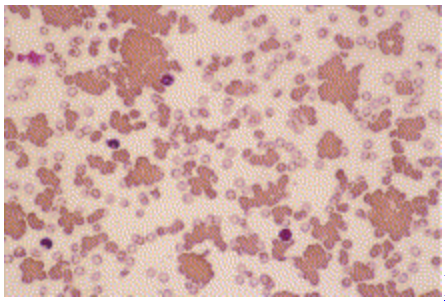

Full-size image (31K)

Figure 5-32.

Cold Agglutinins.

Red blood cell agglutination (large amorphous aggregates) caused by the presence of cold agglutinins.

(Courtesy of Jean Schafer. In Goldman, L: Cecil medicine, ed 23, Philadelphia, 2008, Saunders.)

Coombs' Test

Coombs' test uses an antiserum containing antibodies that bridge antibody- or complement-coated RBCs; bridging causes agglutination (clumping).

Direct Coombs' test

The direct Coombs' test employs antibodies directed against human proteins (primarily IgG and C3) to detect whether these proteins are attached to the surface of RBCs. The direct Coombs' test is used to differentiate between immunologic (e.g., autoimmune) and nonimmunologic (e.g., drug-induced) hemolytic anemias.

Indirect Coombs' test

The indirect Coombs' test detects antibodies against human RBCs in the patient's serum. It is used in crossmatching blood products before transfusion.

Complement

The total serum hemolytic complement (CH_{50}) assay is used to assess the integrity of the complement system by testing in vitro the reaction of the patient's serum with presensitized sheep erythrocytes. CH_{50} values decrease with increased autoimmune disease activity.

Complement Components 3 and 4

Components 3 and 4 (C3 and C4) of the complement system are normally found in relatively high quantities in the serum and are used to diagnose and monitor the progress of autoimmune disease activity. C3 and C4 levels decrease with increased disease activity.

C-Reactive Protein

C-reactive protein, a nonspecific indicator of inflammation, is acutely elevated in rheumatoid arthritis, acute bacterial infections, and viral hepatitis. C-reactive protein level also is sometimes used to differentiate between bacterial and viral meningitis.

Erythrocyte Sedimentation Rate

The ESR is a nonspecific indicator of inflammation. This test measures the rate at which RBCs settle out of mixed venous blood. The rate of settling is influenced by the shape of the RBCs and charges on the membrane. Increased ESR is a nonspecific marker of inflammatory and malignant disease.

Immunoelectrophoresis

Immunoelectrophoresis uses electrophoretic separation and immunodiffusion techniques to separate proteins. It is used to screen for diseases associated with immunoglobulin abnormalities.

Immunoglobulin E

Serum IgE level is elevated in patients with allergic disorders.

Lupus Anticoagulant

The lupus anticoagulant is a circulating immunoglobulin found in patients with autoimmune disease. It prolongs in vitro clotting time by inhibiting phospholipid interactions but is not associated with an increased risk of bleeding in vivo.

Organ-Specific Autoantibodies

Autoantibodies directed against antigens unique to specific organs may be associated with diseases. For example, antibodies may be detected against the thyroid (thyroiditis), RBC membranes (autoimmune hemolytic anemia), platelet membranes (immune thrombocytopenic purpura), glomerular basement membranes (Goodpasture's disease and glomerulonephritis), intrinsic factor (pernicious anemia), and the acetylcholine receptor (myasthenia gravis).

Protein Electrophoresis

Serum protein electrophoresis is used to screen for serum protein abnormalities. The proteins (albumin, $alpha_1$ globulin, $alpha_2$ globulin, beta globulin, and gamma globulin) can be distinguished by the different migration patterns they follow when subjected to an electric field. This test is used in the diagnosis of diseases associated with immunoglobulin abnormalities.

Synovial Fluid Analysis

In addition to being treated with Gram stain and fungal stains and subjected to culture, synovial fluid may be evaluated for the presence and type of crystals. Crystals are characterized by shape,

birefringence in polarized light, and location (intracellular or extracellular). Two main types of crystals may be found in synovial fluid.

Calcium pyrophosphate crystals

Calcium pyrophosphate crystals may be rod shaped, needle shaped, or rhombic (Figure 5-33). They are birefringent and are found intracellularly and extracellularly. They are associated with pseudogout.

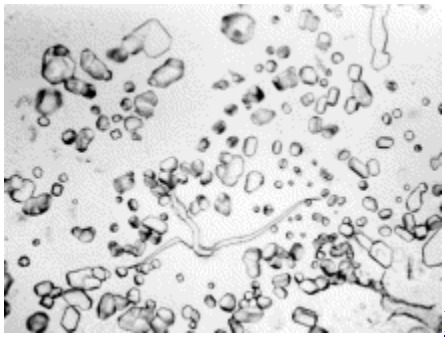

Full-size image (47K)

Figure 5-33.

Calcium Pyrophosphate Crystals.

(From Kumar V, et al: *Robbins and Cotran: pathologic basis of disease*, ed 8, St Louis, 2009, Saunders.)

Monosodium urate crystals

Monosodium urate crystals are needle shaped, are not birefringent, and are found intracellularly and extracellularly (Figure 5-34). They are associated with gout.

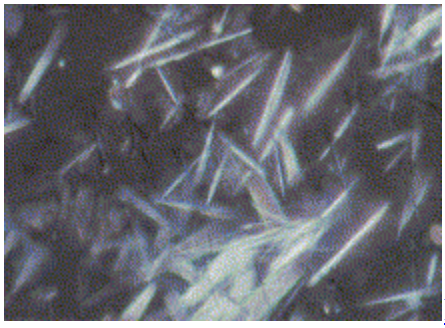

Full-size image (34K)

Figure 5-34.

Urate Crystals.

(From Forbes CD, Jackson WF: *Color atlas and text of clinical medicine*, ed 3, St Louis, 2003, Mosby.)

Uric Acid

Uric acid is the end product of purine metabolism. Low serum levels are associated with Wilson's disease and some malabsorption syndromes. High levels are associated with rapid cellular destruction (as in chemotherapy-associated cell death or malignancies) and disorders of metabolism such as gout.

Venereal Disease Research Laboratory Test

The Venereal Disease Research Laboratory (VDRL) test, used to diagnose syphilis, sometimes gives falsely positive results in connective tissue disease.

Diagnostic Tests and Procedures

Anergy Panel

An anergy panel is used to test the patient's reactivity to a variety of antigens (purified protein derivative antigen, mumps antigen, *Streptococcus* antigen, *Candida* antigen, *Trichophyton* antigen, histoplasmin). The antigens are injected intradermally, and the skin is evaluated for redness and swelling at the injection site. Reaction to one or more of the antigens indicates a responsive immune system. Reaction to a specific antigen indicates that the patient has antibodies to that antigen.

Patch Testing

Patch testing is used to detect delayed hypersensitivity reactions to a variety of allergens. Potential allergens are applied directly to the skin (Figure 5-35). The sites are evaluated in 72 hours for characteristic erythema and blistering indicating positive reactions (Figure 5-36).

Full-size image (51K)

Figure 5-35.

Patch Testing.

Preparation for patch testing.

(From Forbes CD, Jackson WF: *Color atlas and text of clinical medicine*, ed 3, St Louis, 2003, Mosby.)

Full-size image (31K)

Figure 5-36.

Patch Testing.

Patch testing results.

(From Forbes CD, Jackson WF: *Color atlas and text of clinical medicine*, ed 3, St Louis, 2003, Mosby.)

Skin-Prick Testing

Skin-prick testing is used to detect immediate hypersensitivity reactions. Drops of allergen in solution are placed on the skin. The skin is pricked to a depth of about 1 mm by passing a lance or needle through the solution and into the skin (Figure 5-37). The sites are evaluated in about 30 minutes for characteristic wheal formation indicating positive reactions (Figure 5-38).

Full-size image (28K)

Figure 5-37.

Skin-Prick Testing.

Skin-prick (scratch) testing.

(From Forbes CD, Jackson WF: *Color atlas and text of clinical medicine*, ed 3, St Louis, 2003, Mosby.)

Full-size image (31K)

Figure 5-38.

Skin-Prick Testing.

Assessing skin-prick (scratch) testing results.

(From Forbes CD, Jackson WF: *Color atlas and text of clinical medicine*, ed 3, St Louis, 2003, Mosby.)

Infectious Disease

A variety of laboratory and diagnostic tests and procedures are used to diagnose infectious diseases and to monitor patient response to drug therapy.

Laboratory Tests

Acid-Fast Staining

Acid-fast staining (Figure 5-39) is used to screen for the presence of *Mycobacterium, Nocardia*, and *Legionella* species in body tissues and fluids. Some oocysts, such as *Cryptosporidium*, can be detected with the acid-fast stain.

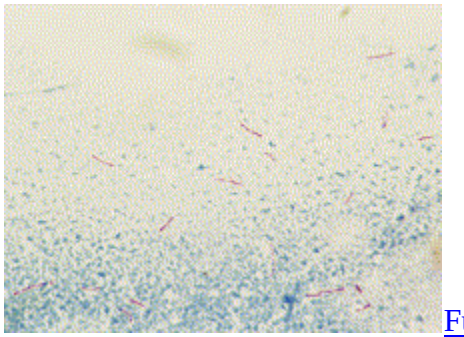

Full-size image (41K)

Figure 5-39.

Acid-Fast Staining.

Acid-fast bacilli that retain a pink color after application of the acid-fast staining procedure.

(From Young AP, Kennedy DP: *Kinn's: the clinical medical assistant: an applied learning approach*, St Louis, 2003, Saunders.)

Cerebrospinal Fluid Analysis

The CSF is analyzed for the presence and quantity of RBCs, WBCs, glucose, and protein. If indicated, stains (Gram stain and acid-fast stain) and potassium hydroxide and India ink preparations are used to evaluate the fluid. Normally, the CSF is clear, without blood or organisms. The CSF glucose level is normally about two thirds the serum blood glucose level. Viral meningitis is characterized by a negative result with Gram staining and normal protein and glucose levels. Fungal and tuberculous meningitis are characterized by negative Gram stain findings, normal protein levels, and low glucose levels. Bacterial meningitis is characterized by cloudy CSF, increased WBCs, elevated protein level, and frequently a positive result with Gram staining.

Cold Agglutinins

Cold agglutinins are antibodies that bind to the surface of RBCs and agglutinate (clump) when the blood sample is cooled. About 50% of patients with *Mycoplasma pneumoniae* infections have high cold agglutinin titers.

C-Reactive Protein

C-reactive protein, a nonspecific indicator of inflammation, is acutely elevated in rheumatoid arthritis, acute bacterial infections, and viral hepatitis. C-reactive protein level is sometimes used to differentiate between bacterial and viral meningitis.

Culture and Sensitivity Testing

Cultures of body fluids and tissues identify specific infecting organisms. In vitro testing is used to determine antibiotic susceptibilities (Figure 5-40).

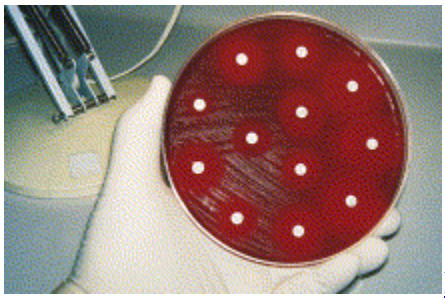

Full-size image (36K)

Figure 5-40.

Antibiotic Sensitivity Testing

Zones of inhibition of bacterial growth are seen around antibiotic sensitivity disks.

(From Young AP, Proctor DB: *Kinn's the medical assistant: an applied learning approach*, ed 11, St Louis, 2011, Saunders/Elsevier.)

Cytotoxicity Toxin Assays

The presence of some infectious microorganisms is detected by identifying specific toxins produced by them rather than the organism itself. For example, *Clostridium difficile* is detected by the presence of a toxin in the stool.

Gram Staining

Gram staining is used to evaluate a body fluid or specimen for the presence of microorganisms (Figure 5-41). Organisms are classified according to their gram-positive or gram-negative color characteristics, morphology (e.g., coccus, rod), and other features (e.g., chain or cluster formation).

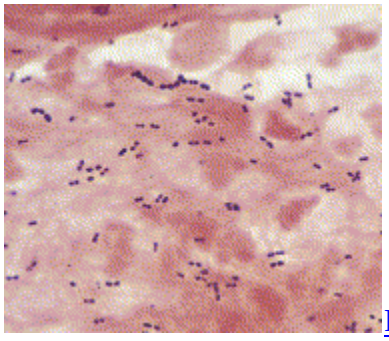
 Full-size image (33K)

Figure 5-41.

Gram Staining.

Streptococcus pneumoniae in a Gram stain preparation.

(From Murray P: *Medical Microbiology*, ed 5, Philadelphia, 2005, Mosby.)

India Ink Preparation

The India ink preparation is used to detect *Cryptococcus neoformans* in a variety of body fluids (Figure 5-42). The carbons in India ink are unable to penetrate the organism, which enables the microscopic identification of the organism by its lack of staining.

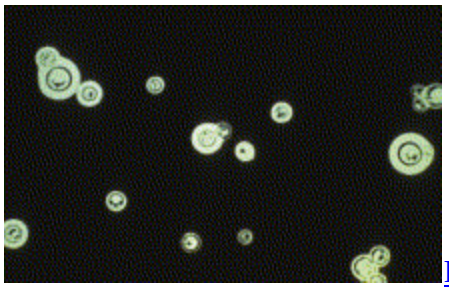

Full-size image (14K)

Figure 5-42.

India Ink Preparation.

Cryptococcus neoformans in an India ink preparation. (From Murray P: *Medical Microbiology,* ed 5, Philadelphia, 2005, Mosby.)

Minimal Bactericidal Concentration

The minimal bactericidal concentration (MBC) is the lowest antibiotic concentration that kills at least 99.9% of the bacteria in the original inoculum. It is used to determine the susceptibility of the organism to antibiotics.

Minimal Inhibitory Concentration

The minimum inhibitory concentration (MIC) is the lowest antibiotic concentration that completely inhibits the visible growth of a microorganism. It is used to determine the susceptibility of the organism to antibiotics.

Potassium Hydroxide Preparation

Potassium hydroxide (KOH) (10% to 20%) is used to detect fungi in body fluids and skin scrapings.

Rapid Plasma Reagin Test

The rapid plasma reagin (RPR) test is used to screen for syphilis. It detects antibodies against antigens from damaged host cells.

Serologic Tests

Serologic tests are used to identify an antigen or antibody to help diagnose infectious disease and to monitor the immunologic response to the microorganism. Acute phase titers are sometimes compared. Examples of serologic tests include the antistreptolysin-O (ASO) titer, cold agglutinin titers, cryptococcal titers, and hepatitis viral serologic testing.

Venereal Disease Research Laboratory Test

The VDRL test, used to diagnose syphilis and neurosyphilis, detects antibodies against antigens from damaged host cells. The VDRL test is not as sensitive as the RPR test.

Wet Mounts

Wet mounts of body fluid specimens are examined microscopically for the presence of parasites and fungi.

White Blood Cell Count and Differential

The WBC count is often elevated in patients with bacterial and viral infections. A left shift (increased bands and segmented neutrophils) indicates a bacterial infection. The lymphocyte count may be elevated in viral infections. The eosinophil count may be elevated in parasitic infections. Elderly patients and those with impaired immune systems or very severe infectious diseases may not be able to mount a WBC response to infection.

Neurologic System

The neurologic system is evaluated with several specialized diagnostic tests and procedures.

Diagnostic Tests and Procedures

Cerebrospinal Fluid Analysis

A lumbar puncture (spinal tap) is used to obtain cerebrospinal fluid for analysis. The fluid is assessed for each of the following characteristics.[4]

Cell count

There are normally no cells in the CSF. The WBC count may be increased in infections or inflammatory conditions. The presence of RBCs may indicate a traumatic tap or subarachnoid hemorrhage.

Color

The CSF normally has no color. Discoloration due to the presence of RBCs ranges from frankly bloody to pink to yellow (xanthochromia) as the RBCs degrade

Glucose

The normal CSF/serum glucose ratio is 0.6. A variety of infections, including bacterial meningitis, mycobacterial infection, and fungal infections, are associated with a lower than normal CSF glucose level. Other causes of low CSF glucose include subarachnoid hemorrhage and some malignancies.

Opening pressure

The normal opening pressure is 60 to 200 mm Hg. Infections, bleeding, and tumors may increase the CSF pressure.

Protein

The CSF normally contains very low concentrations of protein (23 to 38 mg/dL). The CSF protein level may be elevated with a traumatic tap, subarachnoid hemorrhage, diabetes mellitus, or meningitis.

Other tests

The CSF fluid may be tested with fungal and Gram stains, cultured, or subjected to cytologic testing.

Cold Caloric Test

The cold caloric test assesses brainstem function in comatose patients. The intact external auditory canal is filled with ice-cold water. Both eyes will move toward the cold ear and then snap back to the center if brainstem function is normal.

Edrophonium (Tensilon) Test

The edrophonium test is used to diagnose myasthenia gravis and to determine whether the maintenance dosage of acetylcholinesterase inhibitor is appropriate. Edrophonium is administered parenterally, and the muscle strength of the patient is evaluated subjectively.

Electroencephalography

Electroencephalography (EEG) (Figure 5-43) records the electrical activity of the brain from electrodes attached to the scalp. It is used to diagnose seizures, assess patient response to drug therapy, and assess stages of sleep (Figure 5-44).

Full-size image (77K)

Figure 5-43.

Electroencephalography.

Electrodes are attached to the patient's head (**A**) to record brain wave activity (**B**).

(From Chipps E, Clanin N, Campbell V: *Neurologic disorders*, St Louis, 1992, Mosby.)

Full-size image (112K)

Figure 5-44.

Electroencephalography.

Electroencephalogram recorded during an absence seizure.

(Courtesy of Jean Schafer. In Goldman, L: *Cecil medicine*, ed 23, Philadelphia, 2008, Saunders.)

Electromyography

Electromyography (EMG) evaluates muscle action potentials. EMG is used to diagnose muscle disease and to evaluate patient response to therapy.

Peripheral Nerve Stimulation

Peripheral nerve stimulation assesses depth of neuromuscular blockade. Four supramaximal ("train-of-four," or TOF) electrical impulses are applied to a peripheral nerve (ulnar, posterior tibial, facial, or peroneal); the number of resultant twitches is counted. No twitches, one twitch, two twitches, three twitches, and four twitches indicate 100%, 90%, 75%, and 50% blockade, respectively.

Nerve Conduction Studies

The rate of nerve conduction is evaluated by stimulating the nerve and recording the velocity of conduction to electrodes placed over the muscle. Nerve conduction studies are used to diagnose nerve injuries and neuromuscular disease.

Nutrition

Numerous parameters in addition to height and weight are used to assess the nutritional status of a patient and to monitor patient response to nutritional supplementation or total nutritional replacement therapy. Reference ranges for nutritional assessment laboratory tests are listed in Table 5-6.

Laboratory Tests

Albumin

Serum albumin level is an indicator of visceral protein reserves and nutritional status. Protein malnutrition is associated with a serum albumin level of less than 3.5 g/dL if liver function is normal.

Bilirubin

Conjugation of bilirubin requires energy; starvation may cause mild hyperbilirubinemia.

Calcium

Decreased serum albumin level decreases total calcium. However, the serum calcium level does not reflect total body stores.

Creatinine

The 24-hour urinary excretion of creatinine is used to estimate muscle catabolism. Although serum creatinine is not a useful indicator of nutritional status, very low serum creatinine levels may reflect poor nutritional status.

Glucose

Blood glucose level is monitored during nutritional supplementation or total nutritional replacement therapy to assess overall metabolic balance. It is not a useful indicator of nutritional status.

Immunologic Status

Malnutrition may be associated with altered immunologic status. Lymphocyte production may be diminished, which results in a decreased total lymphocyte count. Patients may not be able to mount an immunologic response to skin test antigens.

Magnesium

Decreased serum albumin levels decrease total magnesium. However, the serum magnesium level does not reflect total body stores.

Partial Thromboplastin Time, Activated

Poor nutritional status may be associated with inadequate intake of vitamin K, which results in a deficiency of vitamin K–dependent clotting factors and prolonged clotting time.

Phosphorus

Phosphorus is a metabolic cofactor and intermediate. Refeeding hypophosphatemia may occur in patients with low levels of phosphorus who receive nutritional supplementation or total nutritional replacement therapy.

Transaminases

Starvation compromises cellular membrane integrity and may be associated with increased levels of transaminases (AST and ALT).

Transferrin

Transferrin is an iron transport protein with a shorter half-life than albumin (1 week versus 3 weeks). Serum transferrin level responds more quickly to changes in nutritional status than does albumin level and is a useful indicator of nutritional status.

Urea Nitrogen, Blood

Blood urea nitrogen (BUN) level is a useful indicator of protein breakdown.

Diagnostic Procedure

Anthropometrics

Comparative body measurements assess nutritional status. Parameters such as skinfold thickness of the upper portion of the nondominant arm, middle upper arm circumference (MUAC), and arm muscle circumference (AMC) are assessed. In general, a 20% to 40% decrease compared with normal values is associated with moderate malnutrition. A greater than 40% decrease is associated with severe malnutrition.

Renal System

A variety of laboratory tests are used to diagnose the renal system and monitor patient response to drug therapy. Reference ranges for renal system laboratory tests are listed in Table 5-7.

Laboratory Tests

Arterial Blood Gases

Arterial blood gas (ABG) analysis assesses acid-base balance and ventilation. It is used to diagnose acid-base disturbances and to monitor patient response to drug and nondrug interventions.

Arterial pH

The arterial pH is a quantitative measure of the degree of acidity or alkalinity of the arterial blood.

Base excess

Base excess (BE) is a quantitative measurement of the combined buffering capacity of all body buffering systems, including the bicarbonate system and hemoglobin.

Bicarbonate

The bicarbonate concentration is a quantitative measure of net bicarbonate production and elimination.

Carbon dioxide tension

The arterial partial pressure of dissolved carbon dioxide ($PaCO_2$) is a quantitative measure of net carbon dioxide production and elimination.

Oxygen saturation

The arterial oxygen saturation (SaO_2) is a quantitative measure of the percentage of hemoglobin combined with oxygen. It can be measured noninvasively using pulse oximetry.

Oxygen tension

The arterial partial pressure of oxygen dissolved in the blood (PaO_2) is a quantitative measure of oxygen concentration.

Creatinine

Clearance of creatinine, filtered by the glomeruli, is a useful indicator of renal function.

Electrolytes and Minerals

Serum electrolytes and minerals that are useful to measure when assessing the renal system include calcium, chloride, magnesium, phosphorus, potassium, and sodium. However, the serum concentration of these electrolytes and minerals is variable and does not reflect total body stores.

Calcium (ionized)

Ionized (free) calcium is the physiologically active portion of total serum calcium. Ionized calcium concentration is used to assess calcium status in patients with or at risk of secondary hyperparathyroidism (e.g., in renal failure) and in patients with hypomagnesemia, sepsis, and pancreatitis.

Calcium (total)

Approximately 40% of serum calcium is bound to albumin in a ratio of 0.8 mg/dL of calcium per 1.0 g/dL albumin. Approximately 15% of serum calcium is bound to albumin; the remaining 45% of serum calcium is unbound ionized (free) calcium. Total serum calcium level, the sum of bound and free calcium, is used to assess calcium metabolism and to screen for and evaluate the

response to therapy for bone tumors, primary and secondary hyperparathyroidism and hypoparathyroidism, renal failure, and acute pancreatitis.

Chloride

Chloride is an extracellular electrolyte. Serum chloride concentration is increased in renal tubular acidosis and primary hyperparathyroidism. It is decreased by the administration of drugs such as thiazides, loop diuretics, and corticosteroids.

Magnesium

Magnesium is an intracellular electrolyte. Serum magnesium concentration is used in the assessment of magnesium deficiency and the monitoring of replacement therapy.

Phosphorus

Phosphorus is present in bone (about 85% of the total) and skeletal muscle (about 10% of the total). The serum phosphorus concentration is always in a 1:1 ratio with the serum calcium concentration. Serum phosphorus is used in the diagnosis of hypoparathyroidism and the assessment of bone metabolism.

Potassium

Potassium is an intracellular electrolyte. The serum concentration is sensitive to changes in acid-base status. Serum potassium level is elevated in acidosis, dehydration, and renal insufficiency, and increases in response to administration of some drugs, such as spironolactone. It is decreased in overhydration and alkalosis, and declines with administration of drugs such as corticosteroids, amphotericin, and lithium carbonate.

Sodium

Sodium is an extracellular electrolyte measured to assess water and sodium balance. Serum sodium concentration is increased in dehydration. It is decreased in Addison's disease and by diuretic therapy, ascites (due to dilution), congestive heart failure, renal insufficiency, and excessive water intake.

Gram Staining and Culture

Normal urine contains no bacteria or yeasts. Bacteria are present in urinary tract infections and pyelonephritis. Gram staining and culture identify the cause of the infection and aid in monitoring patient response to drug therapy. Yeast infections are found in immunocompromised hosts and sometimes in association with broad-spectrum antibiotic therapy.

Osmolality

The urine and serum osmolalities are measured and compared to assess the kidney's ability to concentrate the urine. The normal urine/serum osmolality ratio is > 1.3:1. Ratios of less than 1:1

indicate distal tubular disease. Ratios greater than 1.25 indicate decreased glomerular filtration rate.

Urea Nitrogen, Blood

BUN, the end product of protein metabolism, is excreted by glomerular filtration. Although BUN is used as an indicator of renal function, it is less reliable than serum creatinine, because some of the urea diffuses back into the renal tubular cells after filtration. In addition, liver function and protein intake influence the production of BUN.

Urinary Sodium

The urinary sodium level is used to differentiate between renal failure from prerenal causes (e.g., dehydration) and from parenchymal renal insufficiency. In renal disease the kidneys are unable to conserve sodium, which results in elevated urine sodium levels. Urinary sodium level also is used to diagnose the syndrome of inappropriate antidiuretic hormone secretion (SIADH); in SIADH the serum sodium concentration is low but the urine sodium level is elevated.

Urine Toxicologic Testing

Toxicologic urinalysis is used to detect the presence of drugs in patients with suspected drug overdoses, patients experiencing altered mental status, and patients in drug rehabilitation being monitored for relapse.

Urinalysis

Urinalysis is used to screen for renal and nonrenal disease and to monitor patient response to drug and nondrug therapy. Standard urinalysis consists of macroscopic assessment, chemical screening by dipstick, and microscopic examination of the urine sediment. Quantitative analyses are performed when indicated.

Dipstick screening

Multiple-reagent strips (Figure 5-45) are used to determine the urinary pH and specific gravity and to screen for the presence of bilirubin, blood, glucose, ketones, leukocyte esterase, nitrites, protein, and urobilinogen.

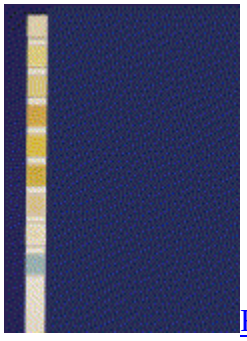

Full-size image (10K)

Figure 5-45.

Urine Dipstick.

(From Forbes CD, Jackson WF: *Color atlas and text of clinical medicine,* ed 3, St Louis, 2003, Mosby.)

Bilirubin

Bilirubin is not normally present in the urine. It is excreted in the urine in the presence of severe liver disease or obstructive biliary disease. The urine appears dark yellow to brown if bilirubin is present.

Blood

Blood is not normally present in the urine. The urine may be visibly bloody, or blood may be found on microscopic or dipstick examination (Figure 5-46). A variety of renal and nonrenal diseases, including urinary tract infections, renal stones, sickle cell disease, glomerulonephritis, and malignant hypertension, are associated with blood in the urine.

Full-size image (21K)

Figure 5-46.

Hematuria.

A positive result for blood (*arrow*) occurred when this reddish brown urine was tested using a urine dipstick.

(From Forbes CD, Jackson WF: *Color atlas and text of clinical medicine,* ed 3, St Louis, 2003, Mosby.)

Glucose

Glucose is not normally present in the urine. Glucose may be found in the urine when the blood glucose level exceeds the renal threshold (>180 mg/dL).

Ketones

Ketones are not normally present in the urine. Urinary ketones may be seen before serum ketones are detectable in diabetic ketoacidosis and may be found in patients who are dieting or are malnourished.

Leukocyte esterase

Leukocyte esterase is not normally present in the urine. This enzyme is found in WBCs and may be detected in the urine during urinary tract and vaginal infections.

Nitrites

Nitrites are not normally present in the urine. *Escherichia coli* organisms convert dietary nitrates to nitrites. Urinary nitrites are associated with *E. coli* urinary tract infections but may only be found if the urine is retained in the bladder for at least 4 hours.

pH

The urinary pH reflects the overall acid-base balance of the body and the kidney's ability to handle acids and bases. The formation of kidney stones is pH dependent. An alkaline pH (pH > 7.0) is commonly associated with the presence of urea-splitting organisms such as *Proteus mirabilis.*

Protein

Small amounts of protein are normally present in the urine (as much as 0.5 g/day). Urinary protein is increased in a variety of renal diseases.

Specific gravity

The specific gravity of urine reflects the kidneys' ability to concentrate urine and the overall state of hydration. The more concentrated the urine, the higher the specific gravity.

Urobilinogen

Urobilinogen is not normally present in the urine. It may be excreted in the urine in the presence of severe liver disease or obstructive biliary disease.

Macroscopic assessment

Color

Freshly voided urine is normally pale yellow. Normal urine may range in color from nearly colorless if very dilute to dark orange if very concentrated. Several drugs discolor the urine, although some color changes depend on the pH of the urine (Table 5-8).

Table 5-8. Medications That Discolor the Urine

Urine Color	Medications

Urine Color	Medications
Blue-green	• Amitriptyline • Indomethacin • Propofol* • Phenol-containing parenteral drugs (e.g., promethazine*) • Methylene blue •
Brown	Metronidazole*
Gray-black	Methyldopa*
Red	• Chlorpromazine • Thioridazine • Laxatives containing phenolphthalein • Senna-containing laxatives • Doxorubicin

Urine Color	Medications
	•
Red-orange	Rifampin

* In the presence of alkaline urine.

Turbidity

Freshly voided urine is normally clear. The urine is turbid (cloudy) if bacteria, WBCs, RBCs, yeast, or crystals are present.

Odor

Freshly voided urine has a fresh distinct odor. Ketones in the urine give the urine a sweet odor. The urine of patients with some metabolic diseases has a distinctive odor, depending on the foods ingested (e.g., maple syrup odor in maple syrup urine disease; fishy odor in trimethylaminuria; odor of sweaty feet in glutaricacidemia type II; mousy odor in phenylketonuria).

Microscopic assessment

The microscopic evaluation assesses the urinary sediment obtained by centrifugation for a variety of casts, cells, and crystals.

Casts

Urinary casts, sometimes known as the *poor man's renal biopsy,* are objects formed within renal tubules (Figure 5-47). Casts are cylindrical and composed mostly of protein and cells. They may be convoluted (spiral) if formed in distal convoluted tubules, broad if formed in dilated collecting ducts, and narrow if formed in narrow lumens.

Full-size image (28K)

Figure 5-47.

Red Cell Cast.

Red cell cast in urine.

(From Forbes CD, Jackson WF: *Color atlas and text of clinical medicine*, ed 3, St Louis, 2003, Mosby.)

Bile casts

Bile casts are acellular casts that contain bile. They are associated with liver disease.

Granular casts

Granular casts are acellular casts that have a granular appearance. They are associated with renal and viral disease and exercise.

Hemoglobin casts

Hemoglobin casts are acellular casts that contain hemoglobin. They are associated with hemolytic anemias.

Hyaline casts

Hyaline casts are acellular casts that consist of a protein matrix. Presence of an occasional hyaline cast may be normal; however, the number of hyaline casts increases with renal disease.

Mixed cellular casts

Mixed cellular casts may contain RBCs, WBCs, and renal tubular epithelial cells. These casts are associated with mixed tubular and interstitial renal diseases.

Red blood cell casts

RBC casts are formed if the glomerular basement membrane is damaged. They may be found in acute and focal glomerulonephritis, lupus nephritis, and trauma.

Renal tubular epithelial cell casts

Renal tubular epithelial cell casts are found in diseases such as hepatitis and cytomegalovirus infection associated with tubular epithelial destruction.

Waxy casts

Waxy casts are acellular casts formed by the breakdown of cellular casts. They are associated with chronic renal disease.

White blood cell casts

WBC casts are associated with interstitial renal inflammation and are found in pyelonephritis.

Cells

Red blood cells

Normally, as many as two RBCs per high-power field may be present in the urine. The number of RBCs in the urine increases with urinary tract infections, stones, and tumors, and with strenuous exercise.

Renal tubular epithelial cells

Renal tubular epithelial cells, shed from the renal tubules, are normally present in the urine.

Squamous epithelial cells

Squamous epithelial cells are normally present in the urine. They are shed from the urethra and vagina.

White blood cells

Normally, as many as five neutrophils per high-power field may be found in the urine. The number of WBCs in the urine increases with renal and urinary tract disease and strenuous exercise.

Crystals

Crystals are found in acidic and alkaline urine. Calcium phosphate and magnesium phosphate crystals form in alkaline urine. Uric acid and amorphous urate and calcium oxalate crystals form in acid urine.

Bilirubin crystals

Bilirubin crystals are reddish brown needles, plates, and cubes associated with jaundice and bilirubinemia.

Calcium oxalate crystals

Calcium oxalate crystals have a classic cross-shaped appearance (Figure 5-48) and are associated with some malabsorptive conditions, ethylene glycol intoxication, and ingestion of megadoses of vitamin C.

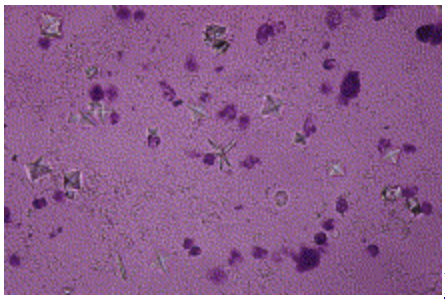
 Full-size image (49K)

Figure 5-48.

Calcium Oxalate Crystals.

Calcium oxalate crystals in urine.

(copyright Ed Reschke. In Pagana K, Pagana T: *Mosby's manual of diagnostic and laboratory tests*, ed 3, St Louis, 2006, Mosby.)

Cholesterol crystals

Cholesterol crystals are flat plates with notched corners associated with the nephritic syndromes.

Cystine crystals

Cystine crystals are hexagonal plates associated with congenital cystinuria.

Leucine crystals

Leucine crystals are round, oily-appearing crystals associated with severe hepatic disease.

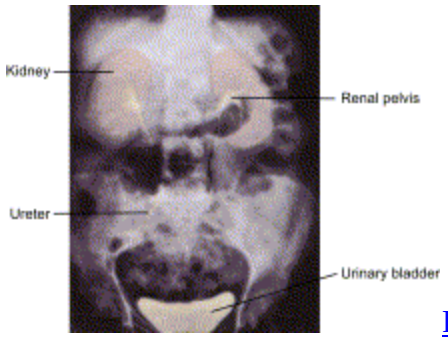
Tyrosine crystals

Tyrosine crystals are fine needles grouped in sheaves that are associated with severe hepatic disease.

Diagnostic Procedures

Intravenous Pyelography

Intravenous pyelography (IVP) is a procedure used to visualize the entire urinary tract (Figure 5-49). A parenteral contrast medium cleared by glomerular filtration is used to detect ureteral obstruction, masses, tumors, and cysts.



Full-size image (25K)

Figure 5-49.

Intravenous Pyelography.

Intravenous pyelogram visualizing the kidneys, renal pelvis, ureters, and bladder following administration of an intravenous contrast medium.

(Hunt SA: *Saunders' fundamentals of medical assistant*, Philadelphia, WB Saunders, 2002.)

Retrograde pyelography

Retrograde pyelography is used to visualize the urine-collecting systems independent of renal function. Contrast media are instilled through a catheter placed in the bladder.

Respiratory System

A variety of laboratory tests and diagnostic procedures are used to diagnose respiratory diseases and to monitor patient response to drug therapy.

Laboratory Tests

Arterial Blood Gases

ABG analysis is used to assess the acid-base balance and level of ventilation, to diagnose acid-base disturbances, and to monitor patient response to drug and nondrug interventions. Refer to page 112 for a discussion of the components of ABG analysis.

Carboxyhemoglobin

Carboxyhemoglobin forms in the presence of carbon monoxide (e.g., exposure to smoky house fires, exposure to car exhaust fumes). Carbon monoxide has a greater affinity for hemoglobin receptors than does oxygen, preferentially binding to the receptors and preventing the RBCs from binding and transporting oxygen. The level of carboxyhemoglobin, normally present in very small quantities in nonsmokers, may be elevated in smokers.

Venous Blood Gases

Venous blood gas analysis sometimes is used in place of ABG analysis to assess the level of ventilation and to monitor patient response to drug and nondrug interventions.

Sputum Analysis

Sputum analysis is used to screen for disease and to monitor patient response to drug and nondrug therapy. It consists of macroscopic and microscopic assessments of the sputum.

Macroscopic assessment

Color

Mucus is normally mucoid and clear. Purulent sputum contains pus and is associated with bacterial infection. Yellow sputum is indicative of inflammation. Uniformly rusty-appearing purulent sputum is indicative of pneumococcal (*Streptococcus pneumoniae*) pneumonia.

Bright red streaks in viscid sputum are indicative of *Klebsiella pneumoniae* pneumonia. Greenish black sputum is indicative of infection with gram-negative bacilli.

Odor

Normal sputum is odorless. Foul-smelling sputum is indicative of a bacterial infection.

Viscosity

Normal sputum is thin and watery. Patients with asthma have a very thick, sticky, tenacious sputum.

Volume

Very little sputum is produced normally. The volume of sputum is increased in a variety of diseases, including bronchitis, pneumonia, and tuberculosis.

Microscopic assessment

Charcot-Leyden crystals

Charcot-Leyden crystals are elongated double-pyramid-shaped masses of eosinophils associated with asthma.

Curschmann's spirals

Curschmann's spirals are small bronchi casts present in diseases associated with bronchial obstruction, such as asthma.

Eosinophils

Eosinophils are present in asthma and other hypersensitivity disorders.

Neutrophils

Neutrophils are found in bacterial and fungal pneumonia and chronic bronchitis.

Diagnostic Tests and Procedures

Bronchoscopy

Bronchoscopy is used to visualize the tracheobronchial tree. A flexible bronchoscope is introduced into the tracheobronchial tree through the nose, mouth, or endotracheal or tracheotomy tube. Samples of fluid and tissue may be obtained for Gram staining, culture, and cytologic examination.

Chest Radiography

Chest radiographs (see Figure 5-22) aid in the diagnosis of pulmonary and cardiac disease and the assessment of patient response to drug and nondrug interventions.

Pleural Fluid Analysis

Thoracocentesis is the procedure that is used to obtain a sample of pleural fluid for analysis. The fluid is assessed for each of the following characteristics.[5]

Color

Blood (a bloody red color) is associated with trauma, malignancy, and pulmonary infarction. A straw yellow color is associated with a transudate. A green color is associated with biliopleural fistula. A black color is associated with *Aspergillus niger* infection.

Fluid character

Pus is associated with an empyema. A turbid fluid is associated with inflammatory exudates or lipids. A viscous fluid is associated with mesothelioma.

Fluid odor

An ammonia-like odor is associated with urinothorax. A putrid odor is associated with infection with anaerobic organisms.

Transudate versus exudate

Transudates accumulate when vascular hydrostatic pressures increase, oncotic pressures decrease, or both occur simultaneously. Congestive heart failure is one of the most common causes of transudates. Transudates are also associated with hypoalbuminemia, nephritic syndrome, and peritoneal dialysis. Transudates are characterized by pleural fluid/serum total protein ratio of 0.5 or less and a pleural fluid/serum LDH ratio of 0.67 or less. Exudates contain high-molecular-weight proteins and are caused by a large variety of diseases and conditions (e.g., connective tissue diseases, hypothyroidism, esophageal perforation, infections, malignancies,

trauma, and other inflammatory conditions). Exudates are characterized by a pleural fluid/serum total protein ratio of more than 0.5 and a pleural fluid/serum LDH ratio of more than 0.67.

Other laboratory tests

Other laboratory tests of pleural fluid include total protein, LDH, number of nucleated cells, type and number of cells, pH, glucose, amylase, triglycerides, and cholesterol. The fluid may be examined for the presence of abnormal cells (cytologic analysis) and may be tested by flow cytometry.

Pulmonary Function Testing

Pulmonary function testing is used to diagnose pulmonary disease, to monitor progression of disease, to predict response to bronchodilators, and to monitor patient response to drug and nondrug therapy. Pulmonary function testing is performed using spirometry or body plethysmography. A spirometer detects and records changes in lung volume and flow. Body plethysmography detects changes in intrathoracic pressure and volume. Normal values vary with age, gender, height, and weight. In general, decreases of 20% or more from predicted values are considered significant.

Carbon monoxide diffusing capacity

The carbon monoxide diffusing capacity (DLCO) test is a noninvasive test of lung function. DLCO is an index of the surface area available for gas exchange and is decreased in emphysema, alveolar inflammation, and pulmonary fibrosis.

Forced expiratory volume in 1 second

The forced expiratory volume in 1 second (FEV_1) is the volume of air (in liters) exhaled in the first second during forced exhalation after maximal inspiration. Normally, at least 80% of the forced vital capacity (FVC) is exhaled in the first second. The FEV_1 is used with the FVC to differentiate between obstructive lung disease ($FEV_1/FVC < 70\%$) and restrictive lung disease (reduced FEV_1 and FVC but normal FEV_1/FVC relationship). An FEV_1 of less than 1 L indicates significant lung disease.

Forced vital capacity

The FVC is the total volume of air (in liters) blown out of the lungs during forced exhalation after maximal inspiration. It is used with the FEV_1 to differentiate between obstructive and restrictive lung disease (see preceding discussion of FEV_1).

Peak expiratory flow rate

The peak expiratory flow rate (PEF, PEFR) measures the forced expiratory flow in liters per minute. It is used to monitor disease progression and response to therapy in patients with bronchospastic diseases such as asthma. PEF variability of greater than 30% indicates moderate

to severe persistent asthma. Asthmatic patients monitor PEF at home with inexpensive handheld peak flow meters.

Residual volume

The residual volume (RV) is the volume of air remaining in the lungs after forced expiration. It is measured with body plethysmography. RVs are increased in diseases characterized by small airway obstruction (e.g., asthma).

Tidal volume

The tidal volume (TV) is the volume of air inspired or expired in normal breathing.

Pulse oximetry

Pulse oximetry is a noninvasive transcutaneous technique used to assess oxygen saturation.

Quantitative pilocarpine iontophoresis (sweat test)

The sweat test measures the concentration of sodium in sweat after stimulation of the sweat glands with topical pilocarpine; low-voltage current is applied to aid in the absorption of the pilocarpine. The sweat test is used in the diagnosis of cystic fibrosis.

Ventilation/perfusion scanning

Ventilation/perfusion ($\dot{V}/\dot{Q}$) scanning (see Figure 5-15) is used to compare ventilation and perfusion. Images of the airways taken after the inhalation of radiolabeled tracers are compared with images of the pulmonary vasculature taken after the injection of contrast agents. Normally, ventilated and perfused areas match. This test is commonly used to identify pulmonary emboli.

Biomarkers

A biomarker, as defined by the U.S. Food and Drug Administration (FDA) and National Institutes of Health (NIH) in 1999, is "a characteristic that is measured and evaluated as an indicator of normal biologic processes, pathogenic processes, or pharmacologic response to a therapeutic intervention."[6] In the broadest sense, a biomarker is any clinical biologic measure. Traditional biomarkers include standard protein and enzyme laboratory measures (e.g., creatinine, PT, CK-MB, troponin), imaging (e.g., radiographs), and physiologic assessments (e.g., blood pressure, temperature, heart rate, respiratory rate). Interest in the use of biomarkers greatly increased in the early 2000s, reflecting increased understanding of complex biologic systems, including the gene-based processes (Box 5-1). Hundreds of new biomarkers have been identified, although most remain investigational with limited clinical applicability. Related terms include the following[7] and [8]:

-
    - Proximal biomarker: biomarker that occurs early in the pathophysiologic cascade

- • Distal biomarker: biomarker that occurs late in the pathophysiologic cascade
- • Preventive biomarker: biomarker that prospectively identifies risk of disease
- • Diagnostic biomarker: biomarker that identifies the disease before any clinical signs or symptoms appear
- • Prognostic biomarker: biomarker that stratifies the risk of disease progression
- • Predictive biomarker: biomarker that prospectively identifies patient response to therapy
- • Surrogate end point biomarker: biomarker that substitutes for a clinical end point

Box 5-1.

Biomarker Uses

- • Drug development (efficacy and safety assessments)
- • Diagnosis of disease
- • Staging of disease
- • Identification of disease risk (prognostic)
-

- Stratification of patients (predict response to therapy)

- Monitoring of response to therapy

The pharmaceutical industry and the FDA are very interested in developing consensus regarding the acceptance of specific biomarkers submitted with investigational new drug (IND) applications and new drug applications (NDAs). The FDA is currently pilot testing a process for qualifying specific biomarkers.[9] A biomarker qualification review team (BQRT) reviews all requests, and the FDA determines the acceptability of the biomarker. *Standard biomarkers* are FDA-approved biomarkers. *Qualifying biomarkers* show promise but are not yet FDA approved. *Exploratory biomarkers* are biomarkers of interest.

Pharmacogenetic Biomarkers

A small but increasing number of FDA-approved drug labels (>200) contain pharmacogenetic biomarker information. Pharmacogenetic testing is required for four drugs and recommended for six drugs before prescribing (Table 5-9).[10.], [11.] and [12] Assessment of pharmacogenetic biomarkers is important for optimizing individual drug therapy (e.g., cetuximab is selectively effective against breast cancer tumors that overexpress *EGFR*) and avoiding rare but important drug toxicities (e.g., patients with a homozygous *TPMT* variant are at a higher risk of azathioprine-associated granulocytopenia; patients with the *HLA-B*5701* allele have a higher risk of abacavir-associated hypersensitivity reactions).

Table 5-9. Pharmacogenetic Biomarkers[10.], [11.] and [12]
Data from: Ikediobi ON, Shin J, Nussbaum RL, et al: Addressing the challenges of the clinical application of pharmacogenetic testing. *Clin Pharmacol Ther* 86:28-31, 2009. Flockhart DA, Skaar T, Berlin DS, et al: Clinically available pharmacogenomics tests. *Clin Pharmacol Ther* 86:109-113, 2009. Table of Valid Genomic Biomarkers in the Context of Approved Drug Labels. Available at: http://www.fda.gov/Drugs/ScienceResearch/ResearchAreas/Pharmacogenetics/ucm08337. Accessed December 17, 2009.

Drug	Indication	Biomarker	Comments
Abacavir	HIV infection	*HLA-B*5701*	Testing recommended to identify patients at increased risk for dangerous skin reactions.
Azathioprine	ALL	*TPMT* variants	Testing recommended to identify patients at risk for granulocytopenia.
Carbamazepine	Epilepsy	*HLA-B*1502b*	Testing recommended to identify patients at increased risk for dangerous skin reactions.
Cetuximab	Colorectal cancer	*EGFR* expression	Testing required to identify patients likely to respond to treatment.

Drug	Indication	Biomarker	Comments
Dasatinib	ALL	*BCR/ABL* expression	Testing required to identify patients likely to respond to treatment.
Irinotecan	Colorectal cancer	*UGT1A1* variants	Testing recommended to identify patients at risk for neutropenia.
Maraviroc	HIV infection	CCR5-tropic HIV-1	Testing required to identify patients likely to respond to treatment.
6-mercaptopurine	ALL	*TPMT* variants	Testing recommended to identify patients at risk for granulocytopenia.
Rasburicase	Hyperuricemia	G6PD deficiency	Testing recommended to identify patients at risk for hemolysis.
Trastuzumab	Breast cancer	*HER2/NEU* overexpression	Testing required to identify patients likely to respond to treatment.
Warfarin	Anticoagulation	*CYP2C9/VKORC1*	Testing may be useful to identify patients at increased risk of bleeding.

ALL, Acute lymphoblastic leukemia; *BCR/ABL,* breakpoint cluster region/Abelson; *CCR5,* chemokine C-C motif receptor; *CYP2C9,* cytochrome P-450 enzyme 2C9; *EGFR,* epidermal growth factor receptor; *G6PD,* glucose-6-phosphate dehydrogenase; *HER2/NEU,* v-*erb* erythroblastic leukemia viral oncogene homologue 2; *HIV,* human immunodeficiency virus; *HLA,* human leukocyte antigen; *TPMT,* thiopurine 5-methyltransferase; *UGT1A1,* uridine diphosphate glucuronosyltransferase 1A1; *VKORC1,* vitamin K epoxide reductase complex, subunit 1.

Cardiac Biomarkers

Well-established cardiac biomarkers for detecting an acute myocardial infarction (AMI) include CK-MB and the cardiac troponins. Newer biomarkers with accepted clinical application include the following[13]:

- *Atrial natriuretic peptide (ANP) and brain natriuretic peptide (BNP):* ANP and BNP, secreted by the heart, regulate blood pressure and body fluid balance by antagonizing the renin-angiotensin-aldosterone system and the sympathetic nervous system.

- *C-reactive protein (CRP):* CRP, a protein synthesized by the liver in response to cytokine stimulation, reflects ongoing inflammation and is predictive of increased risk of AMI.

- *QT interval prolongation:* QT interval prolongation often precedes potentially fatal

ventricular arrhythmias but has low sensitivity and specificity for torsades des pointes (TDP).

Other cardiac biomarkers of interest include myeloperoxidase (a WBC degranulation enzyme), ischemia-modified albumin (identifies ischemia before necrosis occurs), placental growth factor (a vascular endothelial growth factor that may be prognostic for acute coronary syndrome), soluble CD40 (sCD40) ligand (a signaling protein that may be prognostic for acute coronary syndrome), and cystatin C (a low-molecular-weight protein that may be prognostic for heart failure).

Cancer Biomarkers

Cancer provides a classic example of how advances in understanding the molecular mechanisms of disease have resulted in the rapid development of relevant biomarkers.[8] *BRCA1* and *BRCA2* gene mutations are used as screening markers to identify patients at increased risk for developing breast and ovarian cancer. Biomarkers that are overexpressed by tumors and detectable in the serum include CEA for colorectal cancer, alpha fetoprotein for primary liver carcinoma, prostate-specific antigen (PSA) for prostate cancer, cancer antigen 125 (CA125) for ovarian carcinoma, and cancer antigen 19-1 (CA19-9) for pancreatic and gastric carcinomas. Although these biomarkers are not necessarily sensitive or specific enough for widespread clinical application, their discovery represents a significant advance. Gene profiling may identify some patients who are at increased risk of recurrent disease (e.g., some types of breast and colon cancer). Pharmacogenetic biomarkers are currently used to identify patients more likely to respond to some types of chemotherapy and to identify patients at increased risk of some adverse drug effects.

Kidney Biomarkers

Serum BUN and creatinine are well-established biomarkers of renal function. However, serum creatinine concentration is influenced by numerous nonrenal factors, including muscle mass, muscle metabolism, age, race, gender, total body volume, and protein intake. Because significant damage must occur before serum creatinine increases, serum creatinine concentration is not a good biomarker for early renal dysfunction. Total urinary protein is the standard biomarker for diagnosing and monitoring some types of protein-losing nephropathies. Newer and more sensitive biomarkers include the following[14.] and [15.]:

- *Cystatin C:* Cystatin C is a cysteine protease inhibitor that is freely filtered by the glomeruli, resorbed in the proximal tubule, and not affected by muscle mass, age, or race. Serum cystatin C level may predict glomerular function better than serum creatinine concentration.

- *Kidney injury molecule 1 (Kim1):* Kim1 is a renal tubular protein and is a very early

indicator of kidney damage.

- *Neutrophil gelatinase–associated lipocalin (NGAL):* NGAL, expressed by the lung, stomach, colon, and kidney, is one of the proteins found earliest in the blood and urine after acute kidney injury.

- *Interleukin-18 (IL-18):* IL-18, a proinflammatory cytokine, is a specific early marker of acute tubular necrosis.

Other Disease-Specific Biomarkers

Alzheimer's Disease

CSF levels of tau proteins (proteins that promote microtubule stability and are required for intracellular transport) may be useful for identifying patients with mild cognitive impairment that may progress to Alzheimer's disease (AD).[16]

Sepsis

Although more than 100 biomarkers have been identified as potentially useful indicators of sepsis, none is currently sensitive or specific enough to be clinically applicable.[17] Biomarkers of interest include endotoxin, tumor necrosis factor (TNF), interleukin-6 (IL-6), procalcitonin (PCT), and CRP. The heterogeneity of sepsis makes it challenging for researchers to identify sensitive and specific diagnostic and prognostic biomarkers.

Application Activities

Answer the following individually or discuss in small groups (two or three people).

- 1. A few people were lost in the desert for several days. They ran out of water 36 hours before being rescued. What laboratory values will be abnormal?

- 2. Which laboratory values will be abnormal if a patient develops penicillin-associated RBC hemolysis?

- 3. A patient has a large pancreatic abscess, and blood cultures are positive for anaerobic organisms. What laboratory values will be abnormal?

- 4. A student is very anxious before an exam. He is so anxious that he vomited several times the night before the exam and is hyperventilating as he starts to take the exam. What abnormalities would be present if a sample for ABG analysis were obtained as he starts to take the exam?

- 5. Based on the laboratory data provided below, determine the most likely problem of each of the following patients.

    - a. A patient who complains of chronic fatigue

Test	**Patient Data**	**Test**	**Patient Data**
Calcium	8.9 mg/dL	WBC count	5200/mm^3
Magnesium	2.2 mg/dL	Hemoglobin	8 g/dL
Phosphorus	4.1 mg/dL	Hematocrit	35%
Albumin	5.1 g/dL	Platelet count	285,000/mm^3
Total bilirubin	0.3 mg/dL	ESR	6 mm/hr
Ammonia	17 mcg/dL	WBC differential:	
AST	24 units/L	Polymorphonuclear cells	58%
ALT	21 units/L	Bands	2%
GGT	22 units/L	Lymphocytes	38%
LDH	250 units/L	Eosinophils	2%
PT	12 sec		
aPTT	27 sec	BUN	6%
Amylase	29 units/L	Creatinine	1.0 mg/dL
		Glucose (fasting)	83 mg/dL
Sodium	140 mEq/L		
Potassium	4.8 mEq/L	RBC count	$3.3 \times 10^6/mm^3$
Chloride	101 mEq/L	MCV	120 μm^3
CO_2 content	26 mEq/L	MCH	30 pg/cell

    - b. A patient who complains of cough

Test	**Patient Data**	**Test**	**Patient Data**

Calcium	8.9 mg/dL	WBC count	18,000/mm^3
Magnesium	2.6 mg/dL	Hemoglobin	16 g/dL
Phosphorus	4.0 mg/dL	Hematocrit	47%
Albumin	4.8 g/dL	Platelet count	325,000/mm^3
Total bilirubin	0.2 mg/dL	ESR	5 mm/hr
Ammonia	21 mcg/dL	WBC differential:	
AST	19 units/L	Polymorphonuclear cells	56%
ALT	18 units/L	Bands	16%
GGT	21 units/L	Lymphocytes	26%
LDH	289 units/L	Eosinophils	2%
PT	13 sec		
aPTT	26 sec	BUN	10 mg/dL
Amylase	32 units/L	Creatinine	1.2 mg/dL
Sodium	142 mEq/L	Glucose (fasting)	96 mg/dL
Potassium	3.9 mEq/L	RBC count	$5.1 \times 10^6/mm^3$
Chloride	103 mEq/L	MCV	88 μm^3
CO_2 content	28 mEq/L	MCH	30 pg/cell

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c. A man who is found unconscious in the subway concourse

Text	**Patient Data**	**Test**	**Patient Data**
Calcium	8.9 mg/dL	WBC count	6600/mm^3
Magnesium	2.5 mg/dL	Hemoglobin	14 g/dL
Phosphorus	3.3 mg/dL	Hematocrit	40%
Albumin	2.5 g/dL	Platelet count	275,000/mm^3
Total bilirubin	1.1 mg/dL	ESR	2 mm/hr
Ammonia	110 mcg/dL	WBC differential:	
AST	398 units/L	Polymorphonuclear cells	58%
ALT	453 units/L	Bands	3%
GGT	399 units/L	Lymphocytes	38%
LDH	785 units/L	Eosinophils	1%
PT	18 sec	BUN	8 mg/dL
aPTT	25 sec	Creatinine	1 mg/dL
Amylase	28 units/L	Glucose (fasting)	75 mg/dL
Sodium	141 mEq/L	RBC count	$4.3 \times 10^6/mm^3$

Potassium	4.2 mEq/L	MCV	88 μm^3
Chloride	99 mEq/L	MCH	28 pg/cell
CO_2 content	26 mEq/L		

o

d. A patient who complains of fatigue and yellow skin

Test	**Patient Data**	**Test**	**Patient Data**
Calcium	9.1 mg/dL	WBC count	7200/mm^3
Magnesium	2.7 mg/dL	Hemoglobin	16 g/dL
Phosphorus	4.1 mg/dL	Hematocrit	46%
Albumin	4.9 g/dL	Platelet count	325,000/mm^3
Total bilirubin	6 mg/dL	ESR	12 mm/hr
Ammonia	21 mcg/dL	WBC differential:	
AST	8500 units/L	Polymorphonuclear cells	58%
ALT	10,350 units/L	Bands	6%
GGT	9400 units/L	Lymphocytes	34%
LDH	999 units/L	Eosinophils	2%
PT	14 sec	BUN	7 mg/dL
aPTT	32 sec	Creatinine	0.9 mg/dL
Amylase	53 units/L	Glucose (fasting)	88 mg/dL
Sodium	138 mEq/L	RBC count	5.2 × 10^6/mm^3
Potassium	4.7 mEq/L	MCV	87 μm^3
Chloride	101 mEq/L	MCH	29 pg/cell
CO_2 content	28 mEq/L		

http://evolve.elsevier/Tietze/

Audio glossary terms

22 animations

SELF-ASSESSMENT QUESTIONS

-

1. Which one of the following is a noninvasive test or procedure?

- a. Venipuncture
- b. Angiography
- c. Paracentesis
- d. Ultrasonography
- e. Radionuclide studies

2. Which one of the following procedures uses external magnetic fields to produce finely detailed images?
    - a. CT
    - b. MRI
    - c. PET
    - d. SPECT
    - e. Doppler echography

- 3. A patient is found to have elevated levels of troponin I, CK-MB, and LDH, and a "flipped" LDH ratio. These results are consistent with which of the following?
    - a. Myocardial infarction
    - b. Pneumonia
    - c. Renal failure
    - d. Cerebrovascular accident
    - e. Liver failure
- 4. Radionuclide angiocardiography is also known as which of the following?
    - a. Electrocardiography
    - b. Lymphoscintigraphy
    - c. MUGA scanning
    - d. Echocardiography

- e. Electrophysiology

- 5. Metyrapone does which of the following?
  - a. Stimulates cortisol synthesis
  - b. Inhibits production of ADH
  - c. Inhibits production of VMA
  - d. Increases urine aldosterone
  - e. Inhibits cortisol synthesis

- 6. Which one of the following tests is used to assess hepatic synthetic function?
  - a. LDH
  - b. Serum albumin
  - c. AST

- d. GGT
- e. Total bilirubin

7. What is a schistocyte?

- a. An RBC fragment
- b. An RBC with a dark center surrounded by a light ring
- c. An RBC shaped like a rod
- d. An RBC with evenly distributed spicules
- e. An RBC with fragments of nuclear DNA

8. Which one of the following T cells defends against extracellular parasites?

- a. Th1 cells
- b. Th2 cells

- c. Th17 cells
- d. iTreg cells

9. Which one of the following is a laboratory test for fungal skin infections?
    - a. RPR test
    - b. VDRL test
    - c. Potassium hydroxide preparation
    - d. WBC count with differential
    - e. Cold agglutinin titer

10. Which one of the following is a quantitative measure of combined body buffering systems?
    - a. $PaCO_2$
    - b. Serum bicarbonate

- c. Oxygen saturation
- d. BE
- e. Serum creatinine

11. The macroscopic evaluation of sputum includes all *except* which of the following?
    - a. Color
    - b. Viscosity
    - c. Volume
    - d. Odor
    - e. Gram staining

12. Which one of the following pharmacogenetic biomarkers is used to identify patients at risk for 6-mercaptopurine–associated granulocytopenia?
    - a. *G6PD*

- b. *HER2/NEU*
- c. *TPMT*
- d. *HLA-B*5801*

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CHAPTER

6 The Patient Case Presentation

LEARNING OBJECTIVES

- List each component of the patient case presentation.
- State the appropriate sequence for providing information in the patient case presentation.
- Given specific patient information, identify its appropriate location in the patient case presentation.
- Identify the appropriate sequence for presenting laboratory and diagnostic test results.

Patient information, including the history, physical examination, medication history, laboratory reports, and progress reports, is available from a variety of documented sources (e.g., patient chart) and undocumented sources (e.g., patients, colleagues). Effective written or verbal communication of this sometimes complex patient-specific information is not possible without a universally accepted structure.

The structured patient case presentation is the accepted tool for presenting and documenting patient information (Box 6-1). Patient care providers use the structured patient case presentation to communicate essential patient information to colleagues and consultants. The spoken case presentation (oral case presentation) is the standard communication tool for the efficient communication of patient information among health care professionals. The written patient case presentation contains all the details of the case; the spoken case presentation may be shorter and may be modified depending on the context of the presentation.[1] For example, the oral case presentation would be subtly different in each of the following situations: presenting the case to the medical team during teaching rounds, presenting the case to an attending physician during attending rounds, presenting the case one on one to a faculty preceptor, and presenting the case to a colleague. As with all health care communications, it is important that health care professionals communicate as clearly as possible and avoid the use of potentially confusing abbreviations, acronyms, and symbols, including those on the "Do Not Use" list (Table 6-1) compiled by the Joint Commission.[2]

The spoken case presentation is an important teaching and evaluation tool for students and other trainees who are expected to locate, organize, and present patient-specific information to preceptors or other clinicians. The student or trainee learns to gather, organize, and present the patient information; the preceptor uses the details of the case as presented to assess the student's or trainee's understanding of the case and clinical reasoning skills. With practice, the student or trainee develops increasingly sophisticated clinical reasoning skills. Pangaro describes the progression of patient case presentation skills as moving through four stages: reporter, interpreter, manager, and educator (RIME).[3] Trainees are initially expected to be able to obtain and communicate correct facts ("reporter"). As the patient case presentation skills develop, trainees are able to apply information to specific patients ("interpreter") and create patient-specific plans ("manager"). With continued experience, the advanced trainee is able to teach the team ("educator").

Presenting the patient case orally is an art form; inexperienced presenters tend to focus on the structure and content and forget that the primary purpose of the presentation is to communicate patient information effectively and efficiently. The presenter should present most of the case from memory, although reference to notes is acceptable for complex cases. The presenter should use appropriate medical terminology and avoid slang (e.g., "labwise," "kinda," "you know," "like"). As the storyteller, the presenter should use the presentation to build the case logically and reasonably without editorializing about the facts or data or commenting on what is normal or abnormal. Presenting the patient case takes practice as evidenced by an Oregon Health Sciences University study that found numerous common deficiencies in student and postgraduate trainee presentations, including failure to indicate reason for admission to the hospital or emergency department in the introduction (27%), omission of severity of patient symptoms (60%), failure to note medications used (31%), and failure to present vital sign values (16% to 38%).[4] Disorganization and omissions confuse listeners and create a longer than necessary presentation because listeners are forced to ask numerous questions to fill in the missing data and clarify the information.[4] It takes practice to create a thorough, well-organized,

smooth-flowing patient case presentation and to learn how to modify the presentation to suit the situation.[1]

COMPONENTS

The patient case presentation is an organized summary of all known patient information. Considered an up-to-date "snapshot" of the patient, the patient case presentation provides a thorough and detailed picture of the patient at the time of the presentation or initial patient interaction (Box 6-2).[5-7] The patient case presentation summarizes pertinent positive and pertinent negative data. *Pertinent positive* data are the abnormal data (e.g., serum potassium level of 6.2 mEq/L; peaked T waves on electrocardiogram). *Pertinent negative* data are normal findings that, given the context of the rest of the patient information, would have been expected to be abnormal (e.g., normal heart rate in

Box 6-1 Patient Case

Time and date: 2 PM, September 4, 2010
Location: Primary care clinic
CC: "I think my diabetes is out of control because I haven't taken any medication in 2 weeks and I feel bad"
HPI: Mr. Eric Martin is a 57 y/o AAM (DOB 7-15-53) who presents to the clinic after being seen in the ED 3 days ago. He presents today stating that he stopped his medications because his refills ran out. He was previously followed by an outside provider but recently lost his medical and pharmacy insurance coverage after getting laid off of his job. Today he c/o polydipsia, polyphagia, and polyuria. He also noticed some tingling in his fingertips in the last week.
PMH: Type II DM × 6 yr, HTN × 8 yr, dyslipidemia × 3 yr, CAD S/P coronary stent 2005, CKD × 1 yr, glaucoma × 2 yr
SH: Married for 40 yr with three children (A&W); recently unemployed, was a truck driver; refused insulin in the past because of his employment; lives in single-story home; + tobacco 1 ppd × 12 yr, tried to quit three times in the past for about 3 mo each time; no alcohol or illicit drugs
FH: M↓80 (type 2 DM), F↓65 (MI × 2, COPD)

MEDICATION HISTORY

Current prescription medications:
glipizide XR (Glucotrol) 10 mg po bid 30 min AC × 3 yr for diabetes
metformin (Glucophage) 1000 mg po bid with food × 3 yr for diabetes
rosiglitazone (Avandia) 4 mg po daily × 2 yr for diabetes
lisinopril (Prinivil) 10 mg po daily × 8 yr for HTN and kidneys
simvastatin (Zocor) 20 mg po hs × 3 yr for dyslipidemia
clopidogrel (Plavix) 75 mg po daily × 8 yr for heart
latanoprost (Xalatan) 0.005% ophthalmic solution 1 gtt ou hs for glaucoma
Past prescription medications:
glyburide (DiaBeta) 5 mg po bid for diabetes × 3 yr (before the current meds were started)
Current nonprescription medications:
ASA 81 mg po daily × 8 yr for heart
calcium carbonate 500 mg po bid × 3 yr for osteoporosis prevention
Past nonprescription medications: None
Complementary and alternative therapies: None currently or in the past
Immunizations: Influenza vaccine November 2008, hepatitis B series (completed 2005)
Drug allergies: PCN (urticaria) as a child; unknown treatment; has not taken since
Adverse drug reactions: None
Adherence: Nonadherent due to financial problems
Diet: Follows a reduced-carbohydrate and low-fat diet; no supplements, stimulants, or suppressants
ROS: + Polyuria, polydipsia, polyphagia, nocturia (3×/night), + paresthesias in fingertips; – blurred vision, CP, SOB, diarrhea

PHYSICAL EXAMINATION FINDINGS

General: WDWN AAM in NAD sitting comfortably on examination table; Wt: 216 lb; Ht: 5′10″
Vital signs: BP 154/93 mm Hg, HR 78 beats/min (regular, normal strength), RR 16 breaths/min , T 98.6° (37°C).
HEENT: NCAT, PERRLA, EOMI, – AV nicking, no JVD
Chest and Lungs: CTAP
CV: RRR, + S_1, + S_2, – S_3, – S_4, PMI 5ICS MCL, – m/r/g
Abdomen: NABS in all four quadrants, soft, NTND
Extremities: 2+ distal pulses, – CCE
Neuro: A&O×3, CN II-XII intact, 5/5 strength in UE & LE, reflexes 2+ throughout
Genitalia: Normal male genitalia

LABS (SEPTEMBER 4, 2010)

TEST	PATIENT DATA
Sodium	140 mEq/L
Potassium	4.2 mEq/L
Chloride	99 mEq/L
CO_2 content	28 mEq/L
BUN	18 mg/dL
Creatinine	1.3 mg/dL
Glucose (random)	318 mg/dL fasting
Calcium (total)	9.0 mg/dL
Hemoglobin	13.8 g/dL
Hematocrit	41%
Hemoglobin A_{1C}	8.3%
WBCs	10,000 cells/mm^3
Platelets	277,000 cells/mm^3
Total cholesterol	219 mg/dL
Total triglycerides	180 mg/dL
HDL	43 mg/dL
LDL	140 mg/dL
ALT	30 units/L
AST	20 units/L
Alkaline phosphatase	139 units/L

Other labs: Microalbuminuria (120 mg/L albumin; reference range, <20 mg/L)

Table 6-1 The Joint Commission "Do Not Use" List of Abbreviations

Do Not Use	Example	Potential Problem	Replacement
U	10 U insulin	Mistaken for "0" (zero), "4," or "cc"	Use "unit"
Q.D., QD, q.d., qd	Dilantin 300 mg Q.D.	Periods mistaken for "I"	Use "daily"
Q.O.D, QOD, q.o.d., qod	Prednisone 7.5 mg Q.O.D.	Periods mistaken for "I" "O" mistaken for "1"	Use "every other day"
Trailing zero	Coumadin 2.0 mg daily	Decimal point missed	Do not use*
Lack of leading zero	Digoxin .125 mg daily	Decimal point missed	Insert leading zero
MS	MS 2 mg IV every 1-2 hr PRN pain	Misinterpreted as morphine sulfate or magnesium sulfate	Use "morphine sulfate" or "magnesium sulfate"
MSO_4, $MgSO_4$	MSO_4 2 g IV one time only	Misinterpreted as morphine sulfate or magnesium sulfate	Use "morphine sulfate" or "magnesium sulfate"

From The Joint Commission: Official "Do Not Use" List. Available at: http://www.jointcommission.org/PatientSafety/DoNotUseList/. Accessed April 6, 2010.
*Exception: trailing zeros may be used to indicate precision of results (e.g., in laboratory and diagnostic test results).

a patient taking beta-adrenergic blocking medication; normal serum creatinine and blood urea nitrogen levels in a patient with a 30-year history of type 1 diabetes). A good patient case presentation provides all the information needed to understand the patient case but spares the listener or reader from a barrage of duplicative, trivial, or irrelevant information. The person presenting or writing the patient case identifies and selects the pertinent details and salient information.

By convention, each component of the patient case presentation is identified by an acronym (Table 6-2). These acronyms not only are used to document the patient case information in the medical record but also are sometimes used during the case presentation. For example, the person presenting the patient case may say "C-C" instead of "chief complaint," "H-P-I" instead of "history of present illness," and "P-M-H" instead of "past medical history," and so on throughout the spoken case presentation.

The presentation sequence for the spoken case presentation is standardized (Box 6-3). The sequence is designed to provide a logical flow of information, starting with information about the current medical issue and finishing with an update on the patient's progress. Listeners and readers relax and listen to or read the information presented when they recognize that the information is presented in the standardized format. Details may be overlooked if the listener or reader has to piece the patient information together or worry about missing important details of the case.

GENERAL PATIENT INFORMATION

General patient information includes the date and time of admission to the hospital or arrival at the clinic or office and the patient's name, age, race, and gender.

Example: Mr. Howard Roth is a 58-year-old WM who presents to clinic today for refills of his antihypertensive medications.

CHIEF COMPLAINT

The chief complaint (CC) is the reason the patient is seeking medical care. The CC is presented and documented in the patient's own words, which provides a sense of the patient's experiences and understanding of the problem and conveys the patient's perception of the urgency and severity of the problem. The patient's own words also provide important information regarding level of education and medical sophistication. For example, few patients have a CC of "I think I'm having a myocardial infarction." Patients are more likely to complain of heavy, squeezing, or crushing chest pain and discomfort. However, patients with chronic disease and/or repeated contact with the health care system and patients who are health care professionals may use sophisticated medical terminology. A patient who has personally experienced a myocardial infarction or a health care professional might come to the emergency department with the CC of "I think I'm having a myocardial infarction."

The CC cannot be expressed by comatose or otherwise nonverbal patients. However, the patient's family or friends may be able to describe the patient's problem, and this information is sometimes presented as the CC with a notation regarding the person supplying the information. Patients referred for specific tests, procedures, and evaluations may not offer a CC. If this is the case, the CC is presented as "Referred for _____" (e.g., "Referred for cardiac catheterization").

Example: "I'm here for my checkup."

Example: "My doctor sent me here because I'm taking Coumadin."

Example: The patient's wife found him unconscious on the living room floor.

Example: Referred for medication therapy management.

HISTORY OF PRESENT ILLNESS

The history of the present illness (HPI) is a narrative that describes the story of the current problem. All characteristic details, such as the specific symptoms, how the problem began or was first recognized, the duration of symptoms, test results from previous evaluations for the same problem, activities and treatments that ease and worsen the problem, and past experiences with the problem, are included in the HPI. Pertinent data from previous hospitalizations and interventions for the same problem, such as dates of admission and discharge, results of tests

Box 6-2 Components of the Patient Case Presentation

1. General information at the time of first contact or admission
   a. Name, age, race, gender
   b. Date of first contact or admission
2. Chief complaint
3. History of present illness
4. Past medical history
5. Family history
6. Social history (use of tobacco, alcohol, illicit drugs; marital status; education; employment; housing)
7. Medication history
   a. Dietary information (restrictions, supplements, stimulants, suppressants)
   b. Current prescription medications
   c. Past prescription medications
   d. Current nonprescription medications
   e. Past nonprescription medications
   f. Current complementary and alternative medicines
   g. Past complementary and alternative medicines
   h. Allergies
   i. Adverse drug reactions
   j. Immunizations
   k. Adherence
8. Review of systems
9. Physical examination findings
   a. General descriptive statement
   b. Vital signs
      (1) Blood pressure
      (2) Heart rate
      (3) Temperature
      (4) Respiratory rate
   c. Pertinent positive and negative findings on physical examination
10. Pertinent positive and negative laboratory and diagnostic test results
    a. Serum electrolytes (sodium, chloride, carbon dioxide content), creatinine (Cr), blood urea nitrogen (BUN), blood sugar (BS)
    b. Complete blood count (CBC), including white blood cell (WBC) count, differential, hemoglobin (Hb), hematocrit (HCT), and platelets (PLTS)
    c. Liver function tests (LFTs)
    d. Urinalysis (UA)
    e. Chest radiograph (CXR)
    f. Electrocardiogram (ECG)
    g. Other tests
11. Patient problem list and initial plans
12. Patient progress
13. Discharge data (if applicable)
    a. Final diagnosis
    b. Discharge medications
14. Plans for follow-up

Table 6-2 Patient Case Acronyms

Abbreviation	Meaning
CC	Chief complaint
HPI	History of present illness
PMH	Past medical history
FH	Family history
SH	Social history
ROS	Review of systems
MedHx	Medication history
PE	Physical examination
Labs	Laboratory and diagnostic test results

Box 6-3 Sequence for Expressing Information during the Oral Patient Case Presentation

General patient information
↓
Chief complaint
↓
History of present illness
↓
Social history
↓
Family history
↓
Medication history
↓
Review of systems
↓
Physical examination findings
↓
Laboratory and diagnostic test results
↓
Problem list and initial plans
↓
Patient progress to date
↓
Discharge data (if applicable)
↓
Plans for follow-up

and diagnostic procedures, medications used to treat the problem, and physiologic data such as serum creatinine and arterial blood gas results, are summarized in the HPI.

The HPI is presented in a logical and temporally appropriate sequence. Enough detail is included to describe the problem, but excessive and repetitive detail is avoided. For example, information presented about pain includes the location, onset, quality (sharp, dull), severity (mild, moderate, severe), duration (acute, chronic), locations to which the pain radiates, interventions that ease the pain (elevation, warmth, cold, food, water, medications), and interventions that worsen the pain (e.g., walking, coughing).

Risk factors for diseases and conditions such as myocardial infarction, hypertension, diabetes mellitus, and tuberculosis are included in the HPI if the patient has been diagnosed with one of these diseases or if the CC suggests a problem with known risk factors. For example, information regarding a family history of cardiac disease and the patient's history of hypertension, smoking, and

previous myocardial infarctions is presented if myocardial infarction is suspected.

The HPI also includes pertinent negative patient information—symptoms and complaints the patient might be expected to have given the current complaint but does not. For example, the HPI for a patient complaining of dizziness might include a statement that the patient does not have a history of fever, vomiting, diarrhea, blood in the stool or urine, chest pain, palpitations, or head trauma.

Example: The patient has an 8-year history of COPD, a 5-year history of hypertension, and a 6-month history of atrial fibrillation. He was last seen in clinic 1 month ago when his COPD medications were modified. He states that his breathing is improved, with less SOB and DOE. He is back to his baseline cough productive of about 1 cup of whitish sputum daily. He gets SOB with one flight of stairs and with one block of walking. His baseline ABG values are pH 7.40, $Paco_2$ 40 mm Hg, Pao_2 65 mm Hg, bicarbonate 24 mEq/L, and Sao_2 88%. He denies fevers, chills, sweating, nausea, vomiting, and diarrhea.

Example: The patient was in her usual state of health until 3 days prior to admission. She thought she was getting a cold and complained of cough, fever, and fatigue. In the middle of the night she began having trouble breathing. Her husband took her to the local emergency department, where she was told she had pneumonia and was sent home with a prescription for levofloxacin. She went home but returned to the local emergency department a few hours later with worsening symptoms. She was admitted to the hospital and started on intravenous levofloxacin and metronidazole but continued to have problems breathing. She was intubated for acute respiratory failure with a Pao_2 of 45 mm Hg on oxygen via a 100% nonrebreather mask and transferred to the medical intensive care unit. She continued to deteriorate, with complete opacification of both lungs on chest radiograph and Pao_2's in the 40s despite FIo_2's of 1 and full ventilatory support. Hospital day 1 sputum Gram stain results were negative, and cultures show no growth to date. She has been transferred to the university medical intensive care unit for management of presumed acute respiratory distress syndrome. She was sedated and paralyzed for transport and arrived on the following medications: cisatracurium 3 mcg/kg/min, morphine sulfate 21 mg/hr, lorazepam 0.05 mg/kg/hr, levofloxacin 500 mg IV every 24 hours (day 3), metronidazole 500 mg IV every 8 hours (day 3).

PAST MEDICAL HISTORY

The past (or prior) medical history (PMH) includes a brief description of patient problems (current or historical) unrelated to the present illness. For example, a patient with hypertension and diabetes may be seeking care for complaints of cough, fever, and chills. The history of hypertension and diabetes is mentioned briefly in the HPI but presented in detail in the PMH.

The PMH includes the approximate dates and duration for each patient problem and information regarding surgical and other major medical procedures (e.g., cardiac catheterization, bronchoscopy, skin biopsy). The abbreviation *S/P* (status post) indicates a past event.

Example: Mild to moderate hypertension for 10 years; type 1 diabetes mellitus for 5 years; glaucoma for 25 years; S/P fractured left tibia in 1979; S/P three-vessel CABG in November 1985; S/P tonsillectomy and adenoidectomy age 7.

Deciding which information belongs in the HPI and which belongs in the PMH is sometimes difficult. Some presenters include a list of all medical problems as part of the initial statement in the HPI (e.g., "The patient is a 72-year-old HM with a history of coronary artery disease, hypertension, and type 2 diabetes who has been referred to the anticoagulation clinic after being diagnosed with a deep vein thrombosis in his left calf."). Generally, if details of the patient's PMH relate directly to the current problem they are included as part of the HPI. For example, if a patient has a chief complaint of angina, details of the patient's history regarding previous myocardial infarctions and cardiac bypass surgery are included in the HPI in addition to being mentioned in the PMH. Details about the patient's past medical history that are completely unrelated to the present illness belong in the PMH.

SOCIAL HISTORY

The social history (SH) contains information about the patient's use of tobacco, alcohol, and illicit drugs. It also contains information about the patient's occupation, marital status, sexual history, and living conditions. Some of this information overlaps with the medication history (i.e., tobacco, alcohol, illicit drug use) but by convention is presented with the SH instead of the medication history.

Tobacco use is quantified in packs per day and pack-years (refer to Chapter 3 for information regarding how to express a patient's smoking history in pack-years). The approximate start and stop dates for usage, as well as the reason for stopping, are noted for tobacco, alcohol, and each illicit drug.

The type, amount, pattern, and duration of alcohol ingestion are described in the SH. For example, alcohol consumption may be described as "a fifth of whiskey daily for the past 15 years" or "a case of beer every weekend for 6 years." The term *social drinking* is sometimes used to describe the drinking habit of patients who do not drink regularly but only when dining out and on other social occasions. However, the term *social drinking* is open to wide interpretation. The person presenting the case should quantify the type, amount, pattern, and duration of alcohol ingestion (refer to Table 3-1 in the Chapter 3). The date and time of the last drink are noted for patients who drink regularly to determine if the patient is at risk of alcohol withdrawal if suddenly prevented from drinking (i.e., admitted to the hospital) or if some of the patient's signs and symptoms could be alcohol related or due to alcohol withdrawal.

The use of illicit or so-called recreational or street drugs may be documented in the SH instead of documenting this information in the medication history. As with the documentation of alcohol use, the amount, pattern, and duration of use of these agents are described in the SH. For example, "The patient smokes marijuana every weekend and has done so for 8 years," or "The patient uses crack cocaine daily and has done so for 3 years." As with

documentation of tobacco use, the date of the last use of these drugs is presented (e.g., "The patient last used cocaine this morning").

The patient's occupation is documented in the SH. This information is important for both diagnostic reasoning and therapeutic planning. For example, a 40-year history of working in a naval shipyard may be an important piece of information for a patient with pulmonary complaints consistent with mesothelioma. Knowing a patient's work schedule and environment before making decisions regarding the best therapeutic regimen for the patient also may be helpful. For example, the selection of a diuretic as the initial drug treatment for a patient with mild to moderate hypertension may not be the best choice if the patient has a work schedule that precludes frequent restroom breaks. Patients who work in crews or groups may be reluctant to be seen taking medication. For these patients, adherence may be enhanced by selecting medications with dosing schedules that permit the medication to be taken in the privacy of the home.

The patient's living conditions are documented in the SH. For example, the person presenting the case may note that the patient lives at home with a spouse and children or is currently living in a shelter for the homeless. For patients with physically limiting diseases such as rheumatoid arthritis and emphysema, information regarding the layout of the house is an important part of the SH.

Example: The patient lives in a single-family two-story house with his wife and youngest child. He is a semi-retired accountant. He used to smoke (2 ppd for 38 years) but quit 3 years ago. He has drunk two or three beers per week for 40+ years and denies using illicit drugs.

FAMILY HISTORY

The family history (FH) consists of a brief summary of the medical histories of the patient's first-degree relatives (parents, siblings, and offspring). Data presented in the FH include information regarding the status (alive or dead) of the patient's parents, siblings, and children; cause of death and age at death for family members who have died; and current health problems of living family members.

A number of abbreviations and shorthand notations are used for the FH. These abbreviations are not employed in verbal presentations but are used to document the FH in the written medical record. Common abbreviations include *M* for mother, *F* for father, *B* for brother, *S* for sister, *GM* for grandmother, and *GF* for grandfather. An arrow pointing up (↑) indicates that the individual is alive, and an arrow pointing down (↓) indicates that the individual is dead. For example, the notation "M↓78 (MI)" indicates that the patient's mother died at the age of 78 of a myocardial infarction.

Example: The patient's mother is alive and well at the age of 78. His father died at 66 of a myocardial infarction. His three children (ages 35, 32, and 23) are alive and well.

The FH may be detailed and well documented for several generations if the patient is suspected of having a genetically linked disease. The patient's family pedigree is documented by using a set of universally recognized symbols (Figure 6-1). The age of each relative may be noted near the symbol.

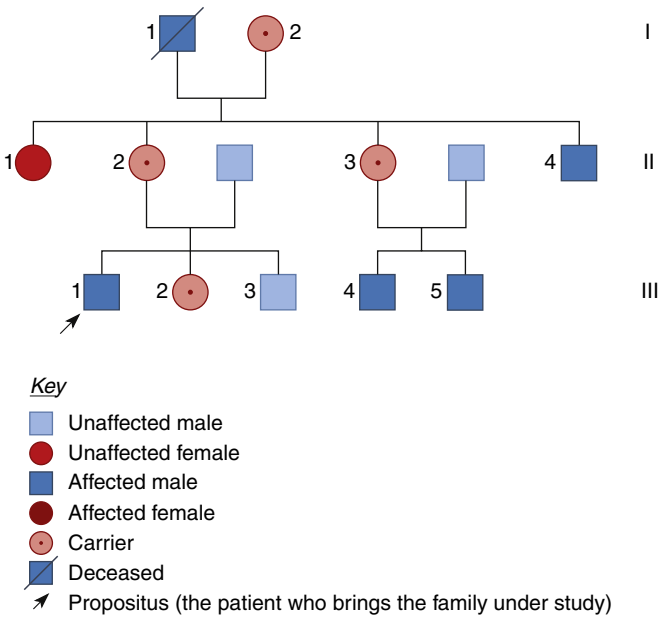

Figure 6-1 Family Pedigree.

MEDICATION HISTORY

Most medication histories (MedHx) obtained and documented by nonpharmacist health care professionals lack the detail of those obtained and documented by pharmacists. Therefore the pharmacist should include the detailed information obtained from the patient medication history interview when making a patient case presentation. (See Chapter 3 for information regarding the patient medication history and Box 3-6 for specific data included in the medication history.)

REVIEW OF SYSTEMS

The review of systems (ROS) summarizes all current patient complaints not included in the HPI. It typically follows an organ system approach (e.g., head, heart, and lung); pertinent positive findings are presented. For example, a patient may have a chief complaint of cough and fever but, when asked about other complaints or problems, may identify chronic constipation. In this example the story of the cough and fever is described in the HPI and the story of the chronic constipation is described in the ROS.

PHYSICAL EXAMINATION

Presentation of the physical examination (PE) findings typically begins with a short description of the patient. The patient description helps listeners or readers visualize the patient and begin to anticipate pertinent findings. The listener or reader obtains different impressions and anticipates the presentation of substantially different data from the PE based on the initial patient description. Note the difference in the impressions given by the following descriptions of three patients:

Patient A is a pleasant, cooperative 48-year-old African American female in no apparent distress.

Patient B is an unconscious white female of unknown age.

Patient C is a 43-year-old Hispanic male who is doubled over and moaning in pain.

The patient's vital sign values, including the blood pressure and heart rate (supine, sitting, or standing as indicated by the patient's initial complaint), respiratory rate, and temperature, follow the initial description of the patient.

Pertinent positive and negative findings from the PE are presented next (see Chapter 4 for information regarding the physical assessment). Pertinent positive findings such as abnormalities found on PE and pertinent negative findings such as abnormalities expected to have been found on PE given the patient's complaints or current or potential medical problems but that were absent on examination are presented in an organized sequence and format. For example, a logical sequence of presentation of this information is to list the findings in order for the skin; head, eyes, ears, nose, and throat (HEENT); heart; chest; abdomen; genitalia; and extremities.

Example:

General: The patient is a pleasant, cooperative WDWN WM in NAD. He is 5′8″ tall and weighs 150 lbs.

Vital signs: BP 120/84 mm Hg, HR 80 beats/min (irregularly irregular, normal strength), RR 12 breaths/min , afebrile.

HEENT: NCAT, EOMI, PERRLA; oropharynx clear; TM WNL; +AV nicking, C/D 30%, no hemorrhages; neck supple with FROM

Chest and lungs: ↑ AP diameter; trachea midline; clear to A&P except for some occasional wheezes and crackles at the bases bilaterally; respiratory excursion WNL; low diaphragm with diaphragmatic excursion 4 cm R & L.

CV: Distant heart sounds; +S_1, +S_2, +S_4; irregularly irregular; PMI 6ICS 2 cm lateral to MCL, no m/r/g.

Abdomen: Soft, NTND, NABS

Extremities: No CCE; numerous hematomas in various stages of healing on arms and legs

Neuro: A&O×3, CN II-XII intact; gross sensory and motor strength intact; cerebellar function WNL, plantar reflexes down; gait WNL; biceps, triceps, patellar, and Achilles reflexes 2+ B/L

Genitalia: Circumcised male with normal genitalia

LABORATORY AND DIAGNOSTIC TEST RESULTS

Results from laboratory and diagnostic tests and procedures are presented after the physical assessment section of the patient case (see Chapter 5 for information regarding laboratory and diagnostic tests and procedures). The amount of detail included in the laboratory and diagnostic test result section depends on the severity and complexity of the patient's medical problem. In some simple, straightforward patient cases, simply stating that all laboratory findings or all laboratory findings except the results of one specific test, such as the chest radiograph, were within normal limits may be sufficient. However, many clinicians want to know all baseline laboratory patient data. Students and trainees may be expected to present and comment on the results of every laboratory and diagnostic test and procedure reported for the patient.

There is no single universally accepted sequence for presenting laboratory and diagnostic test results. However, results of common laboratory tests typically are presented first. For example, a common sequence is to present the levels of serum electrolytes (sodium, chloride, potassium, carbon dioxide content), glucose, blood urea nitrogen, and creatinine first (panel-7, simultaneous multichannel autoanalyzer-6 [SMA-6]), followed by the complete blood cell count (white blood cells with differential, hemoglobin, hematocrit, platelets), results of other electrolyte and serum chemistry tests, and findings of macroscopic and microscopic urinalysis. Nonroutine laboratory test results are presented next, followed by a description of electrocardiograms, radiographs, and results of other diagnostic tests and procedures.

Example: Sodium 140 mEq/L, potassium 4.1 mEq/L, chloride 101 mEq/L, blood urea nitrogen 10 mg/dL, creatinine 1.1 mg/dL, random glucose 136 mg/dL; white blood cell count 5800 cells/mm^3, hemoglobin 16 g/dL, hematocrit 48%, platelets 240,000 cells/mm^3; chest radiograph, low flat diaphragm with increased AP diameter; electrocardiogram, no discrete P waves with irregularly irregular ventricular response at 80 beats/min; pulmonary function tests, FEV_1 2.1 (62% predicted), FVC 3.1 L (76% predicted), FEV_1/FVC 81%, PEF 65 L/min.

PATIENT PROBLEM LIST

The patient problem list and initial diagnosis and therapeutic plans are presented after the laboratory and diagnostic test results. The patient problem list is a brief enumeration of the patient's problems, starting with the most acute problem (see Chapter 7 for information regarding problem identification, prioritization, therapeutic planning, and monitoring). It is not uncommon for different health care professionals to come up with different patient problem lists for the same patient case. For example, pharmacists often include patient nonadherence, need for preventive health measures and health screenings (e.g., routine immunizations, blood pressure screening, diabetes screening, colon cancer screening, breast cancer screening), and long-term anticoagulation therapy on the patient problem list.

Example:

1. *Type 1 diabetes mellitus*
2. *Medication nonadherence*
3. *Stage 1 hypertension*
4. *Atrial fibrillation*
5. *Moderate alcohol drinker*
6. *Class 1 obesity*
7. *Penicillin allergy*
8. *Former tobacco smoker*
9. *S/P appendectomy*

PROGRESS

All the information listed so far describes the initial case presentation given at the time of first contact with the patient. However, a great deal more information is available for patients who have been hospitalized or for patients who have had numerous office or clinic visits

for the same medical problems. A patient case presentation may be made at any point in the care of the patient. Information obtained after the initial patient admission or clinic visit is included at the end of the patient case presentation in a logical temporal sequence. The patient case presentation for a hospitalized patient includes the initial patient case information plus a summary of data obtained during the current hospitalization. For example, presenting every vital sign value documented for a patient who has been hospitalized for several days for the management of hypertension is tedious and unnecessary. These data are summarized for the case presentation so that trends and links between treatment and outcomes are identified. For a patient ready to be discharged from the hospital, the oral case presentation includes the plans for patient follow-up.

OTHER INFORMATION

Additional information beyond that described in this chapter is incorporated as part of the patient case presentation when applicable. This information, which may include plans for additional diagnostic procedures and therapeutic interventions, discharge plans, plans for follow-up after discharge from the hospital, and autopsy results, is placed at the end of the patient case presentation.

APPLICATION ACTIVITY

This activity is best done in small groups (three or four people).

Provide each group with a different written patient case record. The *New England Journal of Medicine* weekly case record works very well for this activity; other published case records are also suitable. Give the groups about 30 minutes to work through the written patient case record and organize the information into the components for the spoken patient case presentation. Each group will then give the oral case presentation to the group as a whole and answer clarifying questions from the other groups. The listeners will evaluate the presentation using a checklist of the patient case components and verbal presentation skills.

SELF-ASSESSMENT QUESTIONS

1. A patient had an appendectomy 40 years ago. This information belongs in which section of the patient case?
   a. HPI
   b. PMH
   c. SH
   d. FH
   e. ROS
2. Which of the following is given first when presenting the physical assessment section of the patient case?
   a. General descriptive statement
   b. Neurologic system findings
   c. Cardiovascular system findings
   d. HEENT findings
   e. Pulmonary findings
3. A patient goes to the local medical doctor with angina. The patient describes having several migraine headaches per year. Detailed information about the migraine headaches belong in which section of the patient case?
   a. HPI
   b. SH
   c. FH
   d. ROS
   e. PMH
4. Vital signs include all of the following *except* which?
   a. Blood pressure
   b. Cardiac output
   c. Temperature
   d. Respiratory rate
   e. Heart rate
5. A patient's 96-year-old mother is alive and well. This information belongs in which section of the patient case?
   a. HPI
   b. PMH
   c. SH
   d. FH
   e. ROS
6. Results of which of the following laboratory tests are mentioned first in the patient case presentation?
   a. Chest radiography
   b. Urinalysis
   c. Serum electrolytes
   d. Electrocardiography
   e. Hemoglobin
7. Which of the following laboratory test results are mentioned last in the patient case presentation?
   a. Biopsy results
   b. Lactate dehydrogenase level
   c. Serum uric acid level
   d. Activated partial thromboplastin time
   e. Serum amylase level
8. Which of the following is given first in the patient case presentation?
   a. Patient progress
   b. CC
   c. PE
   d. HPI
   e. Medication history
9. Which of the following is given last in the patient case presentation?
   a. Patient progress
   b. CC
   c. PE
   d. HPI
   e. Medication history
10. Which of the following is given immediately after the physical examination findings in the patient case presentation?
    a. SH
    b. FH
    c. Medication history
    d. PMH
    e. Laboratory results

11. In a family pedigree, what does a closed box with a slash indicate?
    a. Unaffected living male
    b. Affected living male
    c. Unaffected deceased male
    d. Affected deceased male
    e. Propositus
12. A 42-year-old man is admitted with a suspected myocardial infarction. His risk factors for myocardial infarction (smoking, hypertension, positive family history, hypercholesterolemia, and obesity) are listed in which section of the patient case presentation?
    a. HPI
    b. PMH
    c. SH
    d. FH
    e. ROS

evolve WEBSITE

http://evolve.elsevier/Tietze

Audio glossary terms

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CHAPTER

7 Therapeutics Planning

LEARNING OBJECTIVES

- List the components of the therapeutics planning process.
- List the steps involved in patient problem identification.
- Identify subjective and objective patient parameters.
- List the steps involved in problem prioritization.
- Prioritize patient problems.
- List the steps involved in the selection of specific therapeutic regimens.
- Select patient-specific therapeutic regimens.
- Describe the SOAP (*S*ubjective, *O*bjective, *A*ssessment, *P*lan) format.

Effective planning facilitates the selection of appropriate drug and nondrug interventions (including patient education) for specific patient problems and provides a framework for monitoring a patient's response to the drug and nondrug interventions.

The planning process consists of problem identification, problem prioritization, selection of patient-specific drug and nondrug interventions for each problem, and development of an integrated monitoring plan (Box 7-1). Planning also incorporates well-thought-out alternative treatment regimens. Successful planning requires expert knowledge of pharmacotherapeutics, human disease, physical assessment, and laboratory and diagnostic tests (Figure 7-1). Planning incorporates consideration of patient factors that influence therapeutic regimens (e.g., history of nonadherence to medication regimens, prior experience with prescription and nonprescription medications, concurrent medical conditions, other medication regimens) as well as consideration of the way in which medications influence patients (e.g., adverse effects such as drowsiness or dizziness, cost of therapy). This chapter describes the processes for problem identification, problem prioritization, and selection of patient-specific drug and nondrug interventions for each problem; monitoring is discussed in Chapter 8.

1. IDENTIFY THE PROBLEMS

Seek out patient data from all sources; consider all available patient data. Look for relationships among the data, then group the related subjective and objective data together to determine the specific patient problems. Assess each patient problem.

STEP 1—OBTAIN PATIENT DATA

Consider all available patient data. Review all previously charted data (history, physical examination findings, results of laboratory and diagnostic tests) and interview the patient for the patient's medication history. Review all relevant data resources, including data from the current patient chart (hard copy and electronic), data from past charts (e.g., previous hospital admissions), data obtained from patient interviews or interviews with relatives or significant others if the patient is not capable of providing information, and uncharted data available from team members. Seeking out and then identifying relevant data requires patience and methodical scrutiny. Note that the patient's story may vary depending on who interviewed the patient and when the patient was interviewed. Some data may be contradictory. But it is important to gather and then consider all available data.

Patient factors that by themselves appear unimportant may be important when considered in the context of other patient data. *Pertinent positive data* (abnormal findings) include abnormal laboratory results such as a serum potassium level that exceeds the upper limit of the reference range (e.g., serum potassium level of 5.8 mEq/L), abnormal signs and symptoms described by the patient (e.g., the patient's description of the signs and symptoms of her migraine headache), and abnormalities noted on physical examination (e.g., a blood pressure of 160/110 mm Hg), and are relatively easy to identify. *Pertinent negative data* (findings that are normal but, given the patient's disease or condition, would have been expected to be abnormal) are more difficult to recognize, and identifying them requires a good understanding of human disease and pharmacotherapeutics. For example, many patients with longstanding type 1 diabetes mellitus develop diabetic retinopathy. The fact that a patient with longstanding type 1 diabetes mellitus does not have diabetic retinopathy is important negative data. A patient who is adherent to diuretic therapy but is not taking potassium supplements would be expected to have a low serum potassium level. The fact that such a patient has a serum potassium level within the reference range is pertinent negative data.

Create a working list of the data. Experienced clinicians work from mental lists of patient data, but students and less experienced clinicians may find that taking the

time to create a written list of the patient data minimizes the risk of overlooking problems that may impact the decision-making process. Experienced clinicians who work with very complicated patients (e.g., critically ill patients) often create written data lists to avoid overlooking important issues.

Subdivide the data into lists of subjective data and objective data. *Subjective data,* such as coughing, pain, and itching, are describable but cannot be precisely measured or quantified (Box 7-2). Some clinicians view all data obtained directly from the patient (i.e., the chief complaint, the history of the present illness, the past medical history, the family history, the social history, the medication history, the review of systems) to be subjective data, because the data are not verifiable by an independent observer and must be considered just a story. For example, a patient may report that he or she had an oral temperature of 102.5°F (39.2°C). The temperature reported by the patient is considered to be subjective data because of the uncertainty as to whether it is accurate (e.g., Did the patient drink hot or cold liquids a few minutes before taking the temperature? Was the thermometer placed in the mouth correctly? Did the patient read the thermometer correctly? Did the patient really take his or her temperature?). A patient may report that he or she is taking a specific dose of a medication, but without verification from the prescriber and/or pharmacy, the patient's report is subjective. Patient rating scales (e.g., the 10-point pain rating scale) are designed to objectify subjective data but are based on individual patient interpretation of subjective descriptors.

Objective data, such as blood pressure, heart rate, and temperature, are data that can be precisely measured or quantified (Box 7-3). By convention, data that are obtained by the health care professional by direct observation of the patient or are obtained during the physical examination (e.g., crackles, edema, muscle atrophy, pain) but that cannot be precisely quantified are considered objective data because the data were obtained by an objective, trained clinician. Data documented by other health care professionals (e.g., a list of prescribed medications and dosages, description of biopsy results, identification of wheezing) are considered objective data.

Box 7-1 The Planning Process

1. Identify the problems
   - Step 1—Obtain patient data
   - Step 2—Group-related data
   - Step 3—Determine each problem
   - Step 4—Assess each problem
2. Prioritize the problems
   - Step 1—Identify the active problems
   - Step 2—Identify the inactive problems
   - Step 3—Rank the problems
3. Select patient-specific drug and nondrug interventions
   - Step 1—Determine short-term and long-term goals of therapy
   - Step 2—Create a list of options
   - Step 3—Eliminate options based on patient-specific and external factors
   - Step 4—Select appropriate drug and nondrug interventions
     - Select drug dosage, route, interval, and duration of therapy
   - Step 5—Identify alternative interventions
4. Develop a monitoring plan
   - Step 1—Determine specific monitoring parameters
     - Select specific target outcomes
     - Select monitoring intervals for each parameter
   - Step 2—Integrate the monitoring plan
   - Step 3—Obtain data
   - Step 4—Assess the response to therapy

STEP 2—GROUP-RELATED DATA

Evaluate the list of objective and subjective data for possible relationships among the data. This step requires comprehensive knowledge of the signs and symptoms of

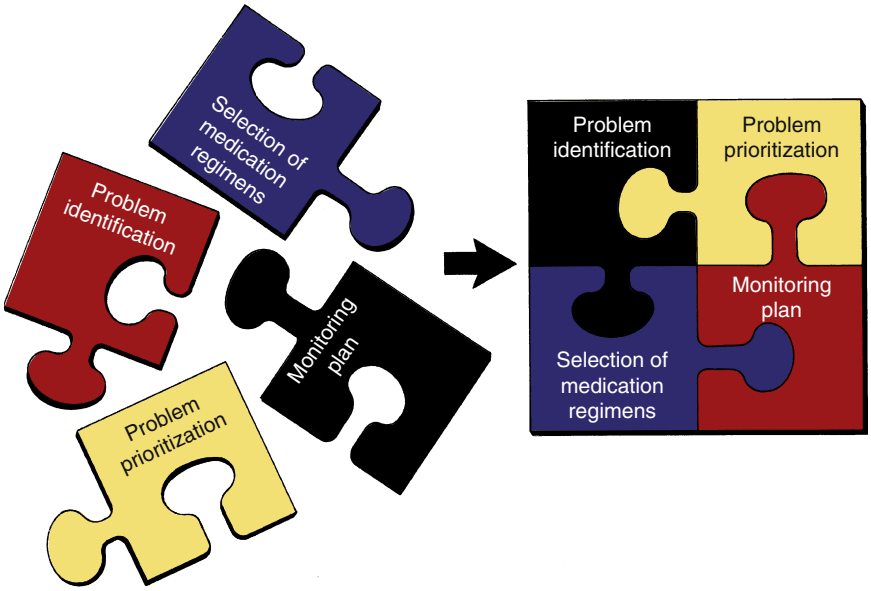

Figure 7-1 Components of Therapeutic Planning.

disease and pharmacotherapy and becomes easier with experience. For example, subjective complaints of fever, one episode of chills, and productive cough combined with objective data of leukocytosis with an increased percentage of bands, a chest radiograph showing right middle lobe consolidation, and sputum positive for gram-positive encapsulated cocci in pairs are related. A less experienced clinician should be able to recognize that the patient has some kind of lower respiratory tract bacterial infection. A more experienced clinician may strongly suspect pneumococcal (*Streptococcus pneumoniae*) pneumonia.

Work through the list of patient data making sure that every piece of patient data is considered. Note that it only takes one piece of data to identify a patient problem. For example, a patient may smoke tobacco but have normal physical examination findings and normal laboratory results. The patient's self-identification of the smoking history is enough to categorize the patient as a smoker. Some data may belong with more than one group of data. For example, a blood pressure of 160/110 mm Hg belongs with data related to the patient's diagnosis of hypertension, but if the patient had been prescribed antihypertensive drug therapy but missed many doses, the blood pressure of 160/110 mm Hg also belongs with data related to patient nonadherence. Some data are of historical interest only but must still be identified and considered in the context of the rest of the patient data (e.g., a patient history of appendectomy 10 years ago).

STEP 3—DETERMINE EACH PROBLEM

Evaluate each group of related subjective and objective data items to determine the specific patient problem or issue. The problem is not always a specific diagnosis but may be a preliminary identification of the issue pending acquisition of additional data (e.g., acute diarrhea, not shigellosis). The problem list is refined as more data become available. Patient problems include current medical problems such as hypertension, pneumonia, asthma, diabetes, and gastrointestinal bleeding; past medical problems such as a history of migraine headache, hip fracture, deep vein thrombosis, and myocardial infarction; past surgeries such as appendectomy, tonsillectomy, coronary artery bypass grafts, and transurethral resection of the prostate; and issues such as nonadherence, obesity, illicit drug abuse, alcohol use, tobacco use, and allergies. Some pharmacists consider medication-related issues such as corticosteroid dependency, long-term anticoagulation therapy, drug interactions, adverse drug reactions, or incorrect dosage (too high a dose, too low a dose) to be identifiable problems and list them as separate problems distinct from the medical condition for which the medication was prescribed (e.g., steroid-dependent asthma, recurrent thrombophlebitis). Other pharmacists prefer to include these medication-related issues with the medical condition.

Box 7-2 Common Subjective Parameters

- Anxiety
- Bloating
- Blood-tinged sputum
- Blurred vision
- Breast tenderness
- Chills
- Cold intolerance
- Confusion
- Constipation
- Cramps
- Decreased appetite
- Depression
- Diarrhea
- Difficulty concentrating
- Dry skin
- Dysuria
- Fatigue
- Flatulence
- Headache
- Heartburn
- Heat intolerance
- Impotence
- Indigestion
- Insomnia
- Incontinence
- Itching
- Joint pain
- Loss of appetite
- Loss of libido
- Muscle aches
- Muscle weakness
- Nasal congestion
- Nasal itching
- Nausea
- Nervousness
- Numbness
- Palpitations
- Pounding pulse
- Rash
- Seizures
- Shortness of breath
- Slurred speech
- Sneezing
- Sore throat
- Syncope
- Thirst
- Tingling
- Tinnitus
- Tremor
- Vertigo
- Weakness
- Wheezing

STEP 4—ASSESS EACH PROBLEM

Each problem is then assessed in terms of each of the following characteristics:

- Acuity (acute or chronic)
- Severity (mild, moderate, or severe)
- Symptom level (symptomatic or asymptomatic)
- Treatment status (treated or untreated)
- Degree of control (controlled or uncontrolled)
- Classification (staging of disease)

Box 7-3 Common Objective Parameters

- Height and weight
- Vital signs: temperature, blood pressure, heart rate, respiratory rate
- Blood chemistry: sodium, potassium, chloride, carbon dioxide content, glucose, creatinine, aspartate aminotransferase, alanine aminotransferase, bilirubin, calcium, magnesium, cholesterol, triglycerides, alkaline phosphatase, lactate dehydrogenase, uric acid, urea nitrogen
- Blood gases: pH, arterial partial pressure of carbon dioxide, arterial partial pressure of oxygen, bicarbonate concentration
- Blood proteins: total protein, albumin, complements, immunoglobulins
- Hematology: hemoglobin, hematocrit, mean corpuscular volume, mean corpuscular hemoglobin concentration, red blood cell count, white blood cell count and differential
- Urinalysis: specific gravity, cellular content, protein
- Culture and sensitivity findings: blood, urine, sputum, tissue
- Serum drug concentrations
- Specific organ systems: peak expiratory flow rate, forced expiratory volume in 1 second, forced vital capacity, ratio of the forced expiratory volume in 1 second to the forced vital capacity, ejection fraction, triiodothyronine level, thyroxine level, thyroid-stimulating hormone level, creatinine clearance

Knowing these characteristics is useful when prioritizing patient problems and when planning patient-specific drug and nondrug interventions. For example, a patient for whom step 1 identifies asthma that is treated and well controlled does not need any change in drug therapy, whereas a patient for whom step 1 reveals asthma that is untreated and uncontrolled does need drug and/or nondrug intervention. Management of a patient's acute, severe, uncontrolled, untreated asthma exacerbation will take precedence over treatment of any of the patient's other chronic and controlled problems. Because historical problems (e.g., a history of a broken leg) cannot be assessed for these characteristics, by convention these problems are simply documented as "S/P" (meaning "status post" or "a history of").

2. PRIORITIZE THE PROBLEMS

The second step in the planning process is prioritization of the patient problems. Prioritization means ranking the patient problems with the most urgent problems at the top of the list and the least urgent problems at the bottom of the list. Prioritization is a way of ordering the relative need for intervention and is not meant to imply a rank ordering of importance or significance to the patient's overall health care needs. Problems of equal urgency are still listed in a rank order although the plans document the need to address each problem simultaneously. Historical (inactive) problems are not ranked but are simply listed at the bottom of the problem list. Problem lists are dynamic lists that evolve and are modified as new data become available.

Problem prioritization helps clinicians plan their workload and patient interventions. For example, an acutely ill patient may also be obese. The acute care pharmacist needs to be aware of the patient's obesity (some drugs are dosed based on actual body weight, some drugs are dosed based on lean body weight, and some drugs are dosed based on adjusted body weight), but the problem of obesity is a long-term issue that is best addressed once the patient has recovered from the acute problem and is discharged home.

STEP 1—IDENTIFY THE ACTIVE PROBLEMS

Active problems are problems that require some kind of drug or nondrug intervention to resolve and/or manage the problem. Examples of active problems include pneumonia, asthma, congestive heart failure, dyslipidemia, osteoporosis, diabetes mellitus, trauma, anxiety, cerebrovascular accident, hypertension, renal failure, hepatitis, leukemia, migraine headaches, and myocardial infarction.

Most clinicians who interact with patients in the ambulatory setting add a "primary disease prevention" problem to the active patient problem list for the purposes of planning and documenting routine immunizations (e.g., annual influenza vaccine, tetanus/diphtheria booster vaccine every 10 years), screening (e.g., blood pressure assessment every 2 to 3 years, annual urinalysis for microalbuminuria for patients at risk of chronic kidney disease), and lifestyle modification recommendations (e.g., exercise 30 minutes a day most days of the week).

STEP 2—IDENTIFY THE INACTIVE PROBLEMS

Inactive problems are problems that do not require any kind of drug or nondrug intervention and are of historical interest only. Examples of inactive problems include a history of an appendectomy at age 12, a history of pneumonia 2 years ago, a history of smoking two packs of cigarettes per day until quitting 10 years ago, a history of illicit drug use 20 years ago, and a history of sulfa-associated rash. Although inactive problems do not require planning for current drug or nondrug therapy interventions, inactive problems are still identified and listed on the patient problem list so that they can be considered when planning drug and nondrug interventions for active problems. For example, a patient with a history of splenectomy is at increased risk of infection with *S. pneumoniae, Haemophilus influenzae, Neisseria meningitides,* and some gram-negative bacteria. Knowledge of this risk will help in planning patient-specific antibiotic therapy in the event that the patient has signs and symptoms consistent with infection. A patient with a history of narcotic addiction should not be prescribed narcotics unless there are no other alternatives, and then only with an awareness of the patient's history of narcotic addiction and close monitoring.

STEP 3—RANK THE PROBLEMS

Rank-order the active patient problems. One approach to ranking patient problems is to identify the problem that needs the most immediate attention and then rank the remaining active problems in order of need for intervention. The number one problem is the problem that if left untreated will cause the most harm to the patient in the shortest amount of time. For example, consider a patient with bacterial meningitis, obesity, and a history of a broken leg as a child. The bacterial meningitis is the patient's number one problem because it is a life-threatening problem that requires immediate intervention. The patient's other active problem is the obesity. But obesity is not as immediately life-threatening as the meningitis and is therefore ranked as the patient's number two problem. The history of a broken leg as a child is an inactive problem and is ranked at the bottom of the list. Another approach is to work from the bottom of the list up by determining the problem requiring the least attention. This problem is ranked as the least important problem. The pharmacist repeats the ranking process with the remaining problems until all are ranked. Regardless of the approach, the active problems are placed at the top of the list, inactive problems are at the bottom of the list, and active but less acute problems are in the middle. As noted previously, the rank ordering is rather arbitrary if the problems all have relatively equal need for intervention.

Clinicians given the same list of patient data may develop different prioritized lists. This is not unexpected; no one list is correct. Lists are developed based on the clinical judgment and experience of the practitioner.

In addition, because the focus of the pharmacist is on therapeutic issues rather than on differential diagnosis, the pharmacist-generated patient problem list may be similar although not necessarily identical to the problem list generated by physicians, nurses, or other health care professionals.

3. SELECT PATIENT-SPECIFIC DRUG AND NONDRUG INTERVENTIONS

Once the prioritized patient problem list is developed, the next step is to select patient-specific drug and nondrug interventions for each patient problem, including initial and alternative drug and nondrug interventions.

Determine appropriate nondrug interventions, including patient education. For example, an important part of the management of allergic rhinitis is avoidance of allergens; patients may benefit from education regarding allergen avoidance. Exercise is important to maintaining a healthy body weight; patients may benefit from reinforcement of the message and suggestions for how much and what type of exercise is important given their other medical conditions. Dietary interventions are important for the management of many chronic diseases such as diabetes mellitus, chronic renal failure, and hypercholesterolemia; patients may benefit from reinforcement of the need to maintain the prescribed dietary practices. Nondrug interventions include reminders for routine vaccines (e.g., annual influenza vaccine) and screenings (e.g., fasting lipid panel every 5 years starting at 20 years of age).

Determine an appropriate medication regimen for each patient problem that can be treated and/or managed with medications. For each medication selected, include the dosage (e.g., 50 mg, 1 g, a pea-sized drop of lotion, one teaspoonful, two puffs), the dosage formulation (e.g., tablet, capsule, liquid, suppository, ointment, dry-powder inhaler), the route of administration (oral, topical, ophthalmic, otic, intravenous, rectal, inhaled), dosing interval (e.g., daily, two times a day, four times a day, every 8 hours, once a month), duration of therapy (e.g., 7 days, one time only, long term), and rationale (the evidence-based reason for selecting the patient-specific therapeutic intervention). The general approach is to develop the therapeutic plan for each problem and then integrate the individual plans, with care taken to ensure that each component of the plan is appropriate given the other plans and that the overall integrated plan is achievable for the patient. For example, when considered individually, plans for therapeutic interventions for a patient with multiple chronic medical conditions may seem reasonable and appropriate, but when considered together they may not be doable if the multiple medication regimens require the patient to adhere to multiple sets of complicated instructions (e.g., take with food, take 2 hours before eating, take every 4 hours around the clock, take every 8 hours around the clock, do not take within 2 hours of taking another medication, etc.).

Selection of a specific regimen requires assessment of each patient problem in the context of everything that is known about the patient such as other patient problems and medications, social habits, cultural beliefs, and willingness to commit to a course of therapy, as well as external factors such as insurance coverage and access to refrigeration for storage of refrigerated medications (Box 7-4). Consider interventions that have and have not worked for the patient in the past, the influence of other patient problems on the proposed medication regimen, the influence of the proposed regimen on all other patient problems, and any cultural-specific medication-related issues. For example, a patient who has responded well to a specific decongestant in the past will most likely respond well to the same decongestant in the future. A patient with renal insufficiency is at risk of developing seizures from the accumulation of normeperidine, a renally eliminated metabolite of meperidine. A drug with negative inotropic effects may worsen a patient's congestive heart failure.

Consider external factors, including the state-of-the-art therapeutics for managing the specific problem, cost considerations, and limitations imposed by institutional and state formularies, when selecting an optimal therapeutic regimen. Rarely is any single therapeutic regimen the only possible appropriate regimen; many different regimens may be equally effective for the patient. The choice between equally effective regimens is based on experience, personal preference, and consideration of external limitations such as restrictive drug formularies or out-of-pocket expenses.

Box 7-4 Factors to Consider When Selecting a Specific Therapeutic Regimen

PATIENT-SPECIFIC FACTORS

What regimens have effectively managed the problem in the past?
What regimens have not effectively managed the problem in the past?
How might other patient problems influence the proposed regimen?
How might the proposed regimen influence other patient problems?
Does the patient have any culturally based needs?

EXTERNAL FACTORS

State-of-the-art therapeutics (e.g., current guidelines)
Cost of the proposed therapy
Formulary limitations

STEP 1—DETERMINE SHORT-TERM AND LONG-TERM GOALS OF THERAPY

All drug and nondrug interventions should be in the context of the specific short-term and long-term goals of therapy, which may or may not be the same depending on the specific patient problem. For example, the short-term goal for a patient being treated for a hypertensive emergency is to reduce the diastolic blood pressure to 100 to 105 mm Hg within 2 to 6 hours of presentation with a maximum reduction of 25% or less of the initial diastolic blood pressure. The long-term goal is to reduce

the diastolic blood pressure to 85 to 90 mm Hg over the next 2 to 3 months to reduce the long-term morbidity and mortality associated with the elevated diastolic blood pressure. The short-term goals for a patient who smokes tobacco and wants to stop smoking is to set a quit date, arrange for the patient to join a support group, and discuss drug therapy options (i.e., transdermal nicotine patch, nicotine gum/lozenge/inhaler/nasal spray, bupropion, varenicline). The long-term goal is for the patient to successfully stop smoking and not resume smoking in the future.

Determine specific goals and outcomes of therapy before doing any other planning. Set specific goals for each patient problem and for the overall therapeutic outcome in general. When setting therapeutic goals, consider long-term factors such as the impact of the therapeutic regimen on the patient's quality of life and survival. For example, a long-term weight reduction plan is not appropriate for a patient with a short life expectancy. Select target therapeutic ranges for all objective parameters (e.g., systolic blood pressure between 110 and 130 mm Hg; serum potassium level between 3.5 and 4.5 mEq/L; weight between 120 and 130 lbs and define specific values that indicate potential toxic effects [e.g., heart rate <50 beats/min], plasma phenytoin concentration >20 mg/L). Select specific subjective outcomes for all subjective parameters (e.g., sleeping through the night without wheezing; no nocturnal leg cramps; anorexia).

Consider the severity of disease and the short-term or long-term nature of therapy when setting therapeutic goals. For example, consider the differences in the goals of insulin therapy for a young patient with newly diagnosed type 1 diabetes mellitus and an elderly patient with a 50-year history of type 1 diabetes mellitus and significant cardiovascular and peripheral vascular disease. Evidence suggests that tight control of blood glucose levels may delay the onset and decrease the severity of the complications of diabetes. Therefore the target blood glucose level for the young patient with newly diagnosed diabetes is lower and has a narrower acceptable range than that for the elderly patient with diabetes and longstanding disease who has already developed complications from the disease and is at risk of hypoglycemia-related falls.

STEP 2—CREATE A LIST OF OPTIONS

Identify all classes of drugs and possible therapeutic approaches for each problem; do not eliminate any option at this stage of planning. The options list is usually a mental list, although students and inexperienced clinicians may find it helpful to create and then work from a written list. Depending on how familiar the pharmacist is with the management of the medical condition, this step may require review of current pharmacotherapeutics and human disease textbooks, literature searches of the current pharmacy and medical literature, review of current treatment guidelines, or consultation with colleagues. This step becomes easier and more time efficient with practice and experience. As the member of the health care team with the most knowledge of pharmacotherapy, it is the pharmacist's responsibility to identify all possible drug therapy options.

STEP 3—ELIMINATE OPTIONS BASED ON PATIENT-SPECIFIC AND EXTERNAL FACTORS

Once all therapeutic options are identified, eliminate options based on the comparative effectiveness of the drugs; the suitability of the drug for the patient given the other patient medical conditions and drug therapies; the ability of the patient to adhere to the proposed regimen; and other factors such as the effectiveness of previous treatment regimens, cost, and formulary restrictions. Consider the impact of the therapeutic option on other patient problems (e.g., the potential adverse effect of beta-adrenergic blocking antihypertensives on patients with asthma) and the influence of other patient problems on the therapeutic option (e.g., the need to reduce the drug dosage in a patient with chronic renal insufficiency).

STEP 4—SELECT APPROPRIATE DRUG AND NONDRUG INTERVENTIONS

Decisions about appropriate drug and nondrug interventions are based on past patient experiences, assessment of the severity of the problem, drug-specific factors such as the therapeutic index of the drug, and specific patient factors such as the presence of chronic renal or hepatic disease that may influence the elimination or metabolism of the drug. Determine the best drug and nondrug regimen, including each specific drug to be used, dosage, route, duration of therapy, and rationale for the selection of each drug and nondrug component of the regimen. For example, if a patient failed to stop smoking because the patient developed varenicline-associated side effects and stopped taking the medication, then the patient should not be prescribed varenicline the next time the patient attempts to quit smoking. If a patient's prescription medication insurance no longer covers a specific branded product, then every effort should be made to find an equivalent medication, generic or otherwise, that is paid for by the prescription medication insurance plan.

The rationale, the reason why the specific intervention was selected, should be patient specific and based on current published evidence. The rationale should be documented in the SOAP note in the patient chart even if verbally discussed with the prescriber. For example, the recommendation to initiate antihypertensive drug therapy with hydrochlorothiazide 12.5 mg daily for a patient with newly diagnosed uncomplicated hypertension is based on the recommendations of the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure.[1] The recommendation to vaccinate or not vaccinate a person with the influenza vaccine is based on current Centers for Disease Control and Prevention recommendations.[2]

STEP 5—IDENTIFY ALTERNATIVE INTERVENTIONS

An important part of the planning process is anticipation of potential patient problems with the prescribed and/or recommended drug and nondrug interventions ("what if"). A well-thought-out plan includes alternative medication regimens for common potential problems, such as the

development of an allergy or adverse reaction to the initial therapeutic regimen, lack of desired therapeutic response to the initial therapeutic regimen, and identification of additional patient problems that may influence the effectiveness or pharmacokinetic profile of the initial therapeutic regimen. Anticipation of these potential issues allows the creation of well-thought-out alternative therapeutic plans instead of therapeutic plans hastily chosen when unanticipated patient problems suddenly appear. For example, therapeutic planning for a patient with newly diagnosed hypertension should include plans for what to do if the initial treatment fails to lower the blood pressure or has to be discontinued because of the development of intolerable side effects (both very common issues).

4. DEVELOP A MONITORING PLAN

Refer to Chapter 8 for discussion of monitoring of drug therapies.

SOAP FORMAT

The process of identifying the subjective and objective data, assessing the problem, and developing a specific therapeutic and monitoring plan is called "SOAPing the problem." The term *SOAP* is an acronym for *S*ubjective, *O*bjective, *A*ssessment, *P*lan.

The SOAP format is the formal and universally recognized organizational structure for identifying and documenting patient problems and the plans for managing the patient problems. Each problem is SOAPed individually, although some clinicians prefer to integrate all data and plans into a single lengthy and potentially complex SOAP note. Some patients may have only one or two problems; in complex cases patients may have 20 or more problems. Regardless of the number of problems, each problem is documented with the relevant subjective and objective data, problem assessment, and plan for managing the problem. A new SOAP note is created with every patient interaction, although typically no more frequently than daily, even for acutely ill patients; however, multiple SOAP notes per day may be written if significant new patient data become available.

APPLICATION ACTIVITY

This activity may be worked on individually or in groups of three or four. Read the "Useful Information for Iguana Bites" before working on the case. Working individually or as a group use the case on pg 143 to do the following:

1. List the patient data.
2. List the subjective and objective data.
3. Group related objective and subjective data together and identify the likely problem.
4. List and prioritize the problems.
5. Create a plan for problem No. 1 (refer to the "Useful Information for Iguana Bites"). Include nondrug therapy and drug therapy (drug, dosage, duration, rationale).

Patient Case Example—Integration and Application

The steps involved in therapeutics planning (problem identification, problem prioritization, and selection of patient-specific drug and nondrug interventions) are illustrated in the following patient case example.

Patient Case
Date: Late August
Location: Outpatient clinic
CC: "There has to be something you can do for my allergies"
HPI: Louisa Sorensen is a 31 y/o F with a 20+ yr history of seasonal allergic rhinitis (SAR) and type 2 diabetes mellitus (DM). She is allergic to ragweed and has symptoms every fall but claims that this fall is much worse than usual. She complains of multiple bouts of sneezing, runny nose, fatigue, irritability, and itchy eyes, nose, and throat. Her symptoms are worse when she is outside and better when she is inside air-conditioned buildings. She's had to trade out of recess duty at work and has not been able to attend her children's soccer games. She has taken every available prescription antihistamine but feels they are not as effective as the nonprescription antihistamines. However, nonprescription antihistamines make her too drowsy to work or drive, so she doesn't take many doses. She started taking nasal cromolyn sodium four times a day a couple of weeks ago. She has taken several short courses of oral steroids in the past but hasn't taken any for several years. She tries to avoid steroids because they make her diabetes hard to control. She denies fever, sore throat, cough, vomiting, or diarrhea.
PMH: Type 2 DM × 10 yr controlled with oral medications and diet; S/P appendectomy age 16 yr
SH: Married, four children (sons 8 and 10 and daughters 4 and 5). Lives in a two-story house in the suburbs. No tobacco, no alcohol, no illicit drugs. Elementary school teacher (teaches first grade).
FH: M↑ (50, + SAR, + asthma), F↑ (51, + SAR); two siblings + SAR; all four of her children + SAR
ROS: As per history of present illness

Medication History
Current prescription medications:
metformin (Glucophage) 1000 mg twice daily × 5 yr
Past prescription medications:
Has tried "every prescription antihistamine available." She says that they "sort of work" but are not as effective as the nonprescription antihistamines. Has taken several different medications for the type 2 DM but cannot remember their names. Has had to use insulin a couple of times while taking prednisone.
Takes prednisone for a few days "when my allergies are really bad"; cannot remember exact dosages or dates

Patient Case Example—Integration and Application—cont'd

Current nonprescription medications:
diphenhydramine (Benadryl Allergy) 25 mg once or twice a day, mostly in the evenings or at night; started about 2 wk ago
cromolyn sodium (NasalCrom) one spray each nostril four times daily during fall allergy season × 2 yr; started about 2 wk ago
Current complementary and alternative medicines:
No current alternative medicines
Past complementary and alternative medicines: Has tried devil's claw, pollen extracts, and echinacea for her allergies without noticeable benefit (unknown dates, dosages, durations)
Immunizations: Had all the usual childhood vaccines; last tetanus/diphtheria booster was 5 yr ago; gets the influenza vaccine every fall
Drug allergies: NKDA
Adverse drug reactions: None
Adherence: Takes her medications as prescribed or recommended
Diet: Low fat (<200 mg cholesterol/day), high fiber (30 g/day), low sodium (<2.4 g/day) with moderate carbohydrates (about 50% of total daily caloric intake)

Physical Examination Findings
General: LS is a pleasant but uncomfortable-appearing woman. She is 5′1″ tall and weighs 180 lb (BMI 34).
Vital signs: Afebrile; BP 114/74 mm Hg; HR 72 beats/min, RR 10 breaths/min
HEENT: PERRLA, EOMI, TM intact; + conjunctival injection; + chemosis; + rhinorrhea (clear watery secretions); pale, swollen nasal mucosa; oropharynx clear except for some postnasal drip; + periorbital edema; + allergic shiners; + allergic crease
Chest and lungs: CTAP
CV: RRR; + S_1, + S_2; PMI 5ICS MCL; no m/r/g
Abdomen: NABS; NTND; appendectomy scar RUQ
Extremities: Strength 5/5 UE and LE; reflexes 2+ UE and LE
Neuro: A×3; cranial nerves II-XII intact

Laboratory Tests and Diagnostic Procedures
Today's labs: Random fingerstick blood glucose 110 mg/dL
Labs from last visit 5 mo ago: Hb A_{1C} 6.5%

1. IDENTIFY THE PROBLEMS
Step 1—Obtain Patient Data
Subjective data:
- "There has to be something you can do for my allergies."
- 20+ history of SAR
- Type 2 DM × 20 yr
- Allergic to ragweed
- Allergy symptoms every fall but are worse than usual
- Multiple bouts of sneezing
- Runny nose
- Fatigue
- Irritability
- Itchy eyes, nose, and throat
- Allergy symptoms are worse outside
- Feels better inside air-conditioned buildings
- Traded out of recess duty
- Unable to attend children's soccer games
- Has taken all available prescription antihistamines but not as effective as nonprescription antihistamines
- Nonprescription antihistamines make her too drowsy to work or drive, which limits their use
- Started nasal cromolyn four times daily 2 wk ago
- Has taken several courses of oral steroids in past
- Avoids steroids (make her DM hard to control)
- No fevers, sore throat, cough, vomiting, or diarrhea
- S/P appendectomy age 16 yr
- + FH for SAR (parents, siblings, and children)
- Diet: Low fat (<200 mg cholesterol/day), high fiber (30 g/day), low sodium (<2.4 g/day) with moderate carbohydrates (about 50% of total daily caloric intake)
- Glucophage 1000 mg twice daily × 5 yr
- Used several different medications for her DM but cannot remember their names
- Has had to use insulin a couple of times while taking prednisone
- Prednisone for a few days in past
- Benadryl Allergy 25 mg 1-2×/day for about 2 wk
- NasalCrom one spray each nostril four times daily for about 2 wk
- Tried devil's claw, pollen extracts, echinacea in the past for her allergies without noticeable improvement
- Had all the usual childhood vaccines
- Last tetanus/diphtheria booster was 5 yr ago
- Gets the influenza vaccine every fall
- Takes her medications as prescribed or recommended

Objective data:
- 5′1″
- 180 lb
- BMI 34
- + Conjunctival injection
- + Chemosis
- + Rhinorrhea (clear watery secretions)
- Pale, swollen nasal mucosa
- Oropharynx clear except for postnasal drip
- + Periorbital edema
- + Allergic shiners
- + Allergic crease
- Appendectomy scar RUQ
- Random fingerstick glucose 110 mg/dL
- Hb A_{1C} 6.5% 5 mo ago

Step 2—Group Related Data
Allergy Group
Subjective data: "There has to be something you can do for my allergies"; 20+ yr history of SAR; allergic to ragweed; allergy symptoms every fall but are worse than usual; multiple bouts of sneezing; runny nose; fatigue; irritability; itchy eyes, nose, and throat; allergy symptoms are worse outside; feels better inside air-conditioned buildings; traded out of recess duty; unable to attend children's soccer games; has taken all available prescription antihistamines but not as effective as nonprescription

Patient Case Example—Integration and Application—cont'd

antihistamines; nonprescription antihistamines make her too drowsy to work or drive, which limits their use; started nasal cromolyn four times daily 2 wk ago; has taken several courses of oral steroids in past; avoids steroids (make her DM hard to control); no fevers, sore throat, cough, vomiting, or diarrhea; + FH for SAR (parents, siblings, and children); Benadryl Allergy 25 mg 1-2×/day for about 2 wk; NasalCrom one spray each nostril four times daily for about 2 wk; has tried devil's claw, pollen extracts, echinacea in the past without noticeable improvement; takes her medications as prescribed or recommended

Objective data: + conjunctival injection; + chemosis, + nasal congestion; + rhinorrhea (clear, watery secretions); pale, swollen nasal mucosa; oropharynx clear except for postnasal drip; + periorbital edema; + allergic shiners; + allergic crease

Diabetes Group

Subjective data: Type 2 DM 10 yr; prednisone increases her blood glucose level; diet: low fat (<200 mg cholesterol/day), high fiber (30 g/day), low sodium (<2.4 g/day) with moderate carbohydrates (about 50% of total daily caloric intake); has used several different medications for her DM but cannot remember their names; had to use insulin in the past when taking prednisone; Glucophage 1000 mg twice daily for 5 yr.

Objective data: 5′1″; 180 lb; BMI 34; random fingerstick glucose 110 mg/dL; Hb A_{1C} 6.5% 5 mo ago

Obesity Group

Subjective data: None

Objective data: 5′1″; 180 lb; BMI 34

Appendectomy Group

Subjective data: S/P appendectomy age 16 yr

Objective data: Appendectomy scar RUQ

Primary Disease Prevention Group

Subjective data: Had all the usual childhood vaccines; last tetanus/diphtheria booster was 5 yr ago; gets the influenza vaccine every fall

Objective data: None

Step 3—Determine Each Problem

- SAR
- DM
- Obesity
- Appendectomy
- Primary disease prevention

Step 4—Assess Each Problem

- SAR: Acute, severe, symptomatic, treated, uncontrolled
- DM: Type 2, chronic, moderate, asymptomatic, treated, controlled
- Obesity: Class I, chronic, moderate, asymptomatic, untreated, uncontrolled
- Appendectomy: S/P appendectomy
- Primary disease prevention: Up-to-date with vaccines; missing other recommended gender- and age-based screenings

2. PRIORITIZE THE PROBLEMS

Step 1—Identify the Active Problems

- SAR
- Type 2 DM
- Obesity
- Primary disease prevention

Step 2—Identify the Inactive Problems

- S/P appendectomy

Step 3—Rank the Problems

Active Problems That Need Immediate Therapeutic Intervention

- SAR

Active Problems Requiring Less Immediate Therapeutic Intervention

- Type 2 DM
- Obesity
- Primary disease prevention

Inactive Problems of Historical Interest

- S/P appendectomy

Of the patient's active problems, her SAR is causing her the most immediate discomfort; interventions are needed to improve the quality of her life. Her type 2 DM and obesity are active problems, but both are stable and do not need immediate intervention. She has not received some of the recommended vaccines and disease screenings for a woman her age with DM. Therefore, this patient's prioritized patient problem list is as follows:

1. SAR
2. Type 2 DM
3. Obesity
4. Primary disease prevention
5. S/P appendectomy

3. SELECT PATIENT-SPECIFIC DRUG AND NONDRUG INTERVENTIONS

Step 1—Determine Short-Term and Long-Term Goals of Therapy

Problem No. 1: Seasonal Allergic Rhinitis

Short-term goal: Reduce patient symptoms

Long-term goal: Initiate preventive therapy before symptoms develop

Problem No. 2: Type 2 Diabetes Mellitus

Short-term goal: Control blood glucose level on a daily basis

Long-term goal: Prevent morbidity and mortality by keeping the Hb A_{1C} value at <7%

Problem No. 3: Obesity

Short-term goals: Refer the patient to a nutritionist for dietary counseling; initiate an exercise program

Long-term goal: Lose 1-2 lb/wk until goal weight achieved; reduce morbidity and mortality by maintaining goal weight

Patient Case Example—Integration and Application—cont'd

Problem No. 4: Primary Disease Prevention

Short-term goal: Bring patient up to date with all recommended vaccinations and screenings

Long-term goal: Reduce morbidity and mortality by prevention of preventable diseases and early identification of other diseases

Problem No. 5: S/P Appendectomy

Short-term goal: Not applicable

Long-term goal: Not applicable

Step 2—Create a List of Options

Problem No. 1: Seasonal Allergic Rhinitis

- Antihistamines
  - Systemic, nonsedating (cetirizine, fexofenadine, loratadine, desloratadine)
  - Systemic, sedating (clemastine, diphenhydramine, tripelennamine, brompheniramine, chlorpheniramine, hydroxyzine, azatadine, cyproheptadine, phenindamine, azelastine)
  - Ocular (azelastine, olopatadine, levocabastine)
  - Nasal (azelastine)
- Decongestants
  - Systemic (pseudoephedrine, phenylephrine)
  - Nasal (phenylephrine, epinephrine, ephedrine, naphazoline, xylometazoline, tetrahydrozoline, oxymetazoline)
- Corticosteroids
  - Systemic (prednisone, cortisone, dexamethasone)
  - Nasal (beclomethasone, budesonide, flunisolide, fluticasone, triamcinolone, mometasone, ciclesonide)
- Anticholinergics
  - Nasal (ipratropium bromide)

Problem No. 2: Diabetes Mellitus

- Drugs that increase insulin release (sulfonylureas [glipizide, glyburide], meglitinides [repaglinide])
- Drugs that increase insulin responsiveness (biguanides [metformin], thiazolidinediones [pioglitazone])
- Drugs that modify intestinal carbohydrate absorption (alpha glucosidase inhibitors [acarbose, miglitol])
- Exogenous insulin

Problem No. 3: Obesity

- Sympathomimetics (phentermine, diethylpropion, ephedra)
- Drugs that inhibit fat absorption (orlistat)

Problem No. 4: Primary Disease Prevention

- Recommended vaccines for the patient's age group: tetanus/diphtheria every 10 yr, annual influenza
- Recommended vaccines for patients with DM: pneumococcal pneumonia polysaccharide, herpes zoster
- Recommended screenings for the patient's gender and age group: visual every 2 yr, dental every 6-12 mo, weight each visit, cholesterol (fasting lipid profile) every 5 yr starting at age 20 yr, annual urinalysis for albuminuria, annual serum creatinine and estimated glomerular filtration rate (eGFR), clinical breast examination every 1-3 yr, optional monthly self-breast examination, annual cervical cancer screening (every 2-3 yr after three consecutive negative test results), human papillomavirus DNA testing every 3 yr

Step 3—Eliminate Options Based on Patient-Specific and External Factors

Problem No. 1: Seasonal Allergic Rhinitis

According to the current practice guidelines, the recommended treatment for moderate to severe SAR consists of a nasal corticosteroid plus an oral nonsedating antihistamine with or without an oral decongestant; short courses of oral corticosteroids may be required.[3] The patient has nasal, ocular, and systemic symptoms. Therefore eliminate single-drug therapy with an ocular or nasal drug. Although the patient has not had an adequate trial of nasal cromolyn sodium, it is unlikely to be effective for severe SAR. Therefore discontinue the nasal cromolyn. The patient feels that nonsedating antihistamines are ineffective but experiences dose-limiting side effects with sedating antihistamines. Antihistamines are more effective if taken regularly, and the patient cannot tolerate the sedating antihistamines. Therefore eliminate the sedating antihistamines. Nasal decongestants are not intended for long-term use. Therefore eliminate nasal decongestants. Systemic decongestants may elevate blood glucose levels in patients with diabetes and are to be used with caution. The patient is not congested. Therefore eliminate systemic decongestants.

Problem No. 2: Type 2 Diabetes Mellitus

The recommended treatment for type 2 diabetes consists of dietary intervention, exercise, and oral hypoglycemics; some patients require short-term or long-term insulin.[4] The drugs that increase insulin release are most effective for patients who are of normal weight or just a little overweight; the patient is obese. Therefore eliminate the drugs that increase insulin release. The drugs that increase insulin sensitivity are expensive, often cause weight gain, and are no more effective than biguanides alone or in combination. Therefore eliminate the drugs that increase insulin sensitivity. Drugs that modify intestinal carbohydrate absorption have additive effects when combined with oral hypoglycemics but are associated with significant gastrointestinal side effects (flatulence, diarrhea), so do not consider them at this time. The patient has good long-term control of her diabetes, so do not consider insulin unless she is going to take oral corticosteroids.

Problem No. 3: Obesity

Dietary intervention and exercise are considered first-line treatments for obesity; pharmacologic intervention is not indicated at this time. Therefore do not consider drug therapy at this time.

Problem No. 4: Primary Disease Prevention

The patient should receive the annual influenza and scheduled tetanus/diphtheria boosters. As a patient with diabetes, she could receive one or two doses of the pneumococcal pneumonia polysaccharide vaccine and the herpes zoster

Patient Case Example—Integration and Application—cont'd

vaccine; discuss with the patient's physician. The rest of the recommended screenings are appropriate for the patient.

Step 4—Select Appropriate Drug and Nondrug Interventions

Problem No. 1: Seasonal Allergic Rhinitis

Given the patient's DM and past history of requiring insulin when taking prednisone and antihistamine-associated drowsiness, a conservative initial approach is best. Once-daily therapy may improve patient adherence. Initiate therapy with a nasal corticosteroid and a nonsedating antihistamine. There is little difference among the marketed nasal corticosteroids except for fluticasone, which is better absorbed than other nasal formulations and potentially associated with more systemic steroid-related side effects. Aqueous dosage formulations may cause less nasal mucosa irritation than other dosage formulations. Initiate therapy with triamcinolone acetonide (Nasacort AQ) two sprays (220 mcg) each nostril once daily. There is little difference among the marketed nonsedating antihistamines except for cetirizine, which is more sedating than other nonsedating antihistamines. Initiate therapy with loratadine (Claritin) 10 mg once daily on an empty stomach. Advise the patient to avoid outdoor activities and to keep her car and house windows closed. Patient should return to the clinic in 2 wk to evaluate the effectiveness of the regimen.

Problem No. 2: Type 2 Diabetes Mellitus

The patient's DM is well controlled on her current regimen. Continue metformin (Glucophage) 1000 mg twice daily. The patient should continue her current diet but reduce the number of calories (see obesity plan). Encourage moderate exercise.

Problem No. 3: Obesity

The patient is obese (BMI 35) and at risk for cardiovascular complications. The goal of therapy is to lose 0.5-1.0 kg/wk for the first 3 mo. Although drug therapy could be initiated (her BMI is >30), the conservative approach is to try a few months of dietary restrictions and moderate exercise. Refer the patient to a nutritionist and encourage the patient to adhere to the recommended dietary plan. Encourage the patient to start a walking program with a target of 30 min of walking 5 days/wk. Encourage the patient to find a "diet buddy" or join a weight loss support group.

Problem No. 4: Primary Disease Prevention

Schedule the influenza vaccine for November. Encourage the patient to schedule appointments with her ophthalmologist, dentist, and gynecologist. Request a fasting lipid profile, urinalysis, and serum creatinine level.

Step 5—Identify Alternative Therapeutic Interventions

Problem No. 1: Seasonal Allergic Rhinitis

The patient may need a short course of oral corticosteroids if her symptoms have not improved after a 2-wk trial of nasal corticosteroids and nonsedating antihistamine. Consider a 10-day course of prednisone (40 mg/day on days 1 and 2; 30 mg/day on days 3 and 4; 20 mg/day on days 5 and 6; 10 mg/day on days 7 and 8; 5 mg/day on days 9 and 10). Insulin may need to be added if prednisone is prescribed.

Problem No. 2: Type 2 Diabetes Mellitus

If prednisone is added to her regimen, instruct the patient to check her blood glucose level before regularly scheduled meals and to treat elevated blood glucose levels with short-acting regular human insulin (1 unit of regular insulin for each 50 mg/dL glucose above 150 mg/dL); instruct the patient to call the clinic if her blood glucose level is >400 mg/dL.

Problem No. 3: Obesity

Consider adding orlistat (Xenical) 120 mg three times daily with meals containing fat (during or up to 1 hour after the meal) if the patient has not lost weight after several months of diet and exercise.

Problem No. 4: Primary Disease Prevention

If the patient gets influenza, recommend oseltamivir (Tamiflu) 75 mg twice daily × 5 days if therapy can be initiated within 48 hours of the onset of symptoms to reduce the severity and duration of symptoms.

Initial Treatment Regimen

The following nondrug and drug interventions are recommended for the patient:

- Initiate therapy with triamcinolone acetonide (Nasacort AQ) two sprays (220 mcg) in each nostril once daily and loratadine (Claritin) 10 mg once daily.
- Advise the patient to avoid outdoor activities and keep car and house windows closed.
- Instruct the patient to return to the clinic in 2 wk for reassessment.
- Continue metformin (Glucophage) 1000 mg twice daily.
- Refer the patient to a nutritionist.
- Advise the patient to start a walking program with a target of 30 minutes of walking 5 days/wk.
- Encourage the patient to make appointments with her ophthalmologist, gynecologist, and dentist.
- Discuss the recommendations for the pneumococcal pneumonia polysaccharide and herpes zoster vaccines with the patient's physician.
- Schedule the influenza vaccine for November.

Useful information for Iguana Bites

Iguanas, increasingly popular as pets, are frequent carriers of unusual subtypes of fecal *Salmonella* organisms. Iguanas inflict injury by scratching, tail whipping, and biting, which can cause significant lacerations. Bite wound care is similar to that for bites inflicted by other animals. Close follow-up for signs of infection is essential.

Treatment

Superficial scratches and bites:

Nondrug therapy: Clean the wound as quickly as possible with soap and water. Cover with bandages.

Drug therapy: None.

Deep puncture wounds or lacerations:
- Nondrug therapy: Clean the wound as quickly as possible with soap and water. Irrigate the wound with copious amounts of saline. Suture all wounds except hand wounds. Apply 1% povidone-iodine to wounds that are going to be sutured. Cover with bandages if sutured; otherwise, do not bandage.
  - Povidone-iodine side effects: irritation, redness, rash
- Prophylactic antibiotics: Ampicillin 500 mg orally four times daily for 5 days. Give ciprofloxacin 250 mg twice daily for 5 days if allergic to penicillin.
  - Ampicillin side effects: Rash, itching, insomnia, agitation, hyperactivity, nausea, diarrhea, confusion, dizziness, ↑ aspartate aminotransferase, ↓ hemoglobin, ↓ platelets, ↓ hemoglobin, ↓ red blood cell count, ↓ hematocrit
  - Ciprofloxacin side effects: Nausea, diarrhea, vomiting, abdominal discomfort, headache, restlessness, rash, nightmares, seizures, ↑ blood glucose, ↑ serum potassium, ↑ serum creatinine, ↑ alanine aminotransferase, ↑ aspartate aminotransferase, ↑ alkaline phosphatase, ↑ lactate dehydrogenase, ↑ serum bilirubin

Application Activity - Patient Case

Time: 9 AM
Location: Outpatient urgent care clinic
CC: "Iggie bit me"
HPI: Marcus, a 29 y/o man, states that Iggie, his 4-yr-old pet iguana, bit him on his right hand this morning as he reached into Iggie's cage to feed him. Marcus says that the wound didn't bleed much but that it really hurts. He describes the pain as throbbing and rates the pain as 6 on a 10-point scale (10 being the worst possible pain). His hand feels better when he holds it up. He washed the bite wound with soap and water, wrapped a towel around his hand, and called his doctor, who told him to go to the outpatient urgent care clinic.
PMH: GERD for 2 yr. His symptoms include heartburn and belching and are worse if he eats tomato-based foods or lies down right after eating. HTN first diagnosed last year. He exercises regularly and avoids salty foods. He takes no medication for the HTN. S/P tonsillectomy age 5 yr.
SH: Works as a computer programmer. Lives in own three-story home. Started drinking alcohol when he was 18 yr and is currently drinking about a six-pack of beer on weekends. Does not smoke tobacco and denies the use of illicit drugs.
FH: Married with two small children (aged 3 yr and 6 mo). M&F A&W. Both parents have HTN.

Medication History
Current prescription medications: Esomeprazole (Nexium) 20 mg daily × 2 yr for the GERD
Past prescription medications: None
Current or past nonprescription medications: None
Current or past complementary and alternative therapies: None
Immunizations: Had all the usual childhood vaccines. Last tetanus/diphtheria vaccine was 3 yr ago. Gets the influenza vaccine every fall.
Drug allergies: Allergic to penicillin. Was given penicillin when his tonsils were removed. Doesn't remember what happened, but his mother told him he almost died and that he should never take penicillin.
Adverse drug reactions: None
Adherence: Says he gets heartburn if he doesn't take the Nexium so he is careful to take the doses.
Diet: Avoids tomatoes and tomato-based foods

Physical Examination Findings
General: Pleasant, cooperative man in obvious distress. 6′2″, 82 kg
Vital signs: BP 140/90 mm Hg, HR 140 beats/min, RR 12 breaths/min, T 98.6° F (oral)
HEENT: PERRLA, EOMI, NCAT
Chest and lungs: CTAP
CV: + S_1, + S_2; II/VI systolic murmur at the apex; no rubs or gallops
Abdomen: NABS, NTND
Extremities: Deep puncture wound on dorsal surface of right hand near thumb. Hand is red and swollen. Unable to feel radial pulse on right.
Neuro: A×3; reflexes 2+ throughout; cranial nerves not tested
Labs: Panel-7 WNL; CBC WNL.

SELF-ASSESSMENT QUESTIONS

1. What does the *A* in the acronym *SOAP* stand for?
   a. Active
   b. Appraisal
   c. Assessment
   d. Acquire
   e. Attainment
2. What does the *O* in *SOAP* stand for?
   a. On the whole
   b. Opportunity
   c. Overall
   d. Objective
   e. Oppose
3. Which one of the following is *not* a component of the planning process?
   a. Problem identification
   b. Problem prioritization
   c. Selection of specific initial and alternative treatment regimens
   d. Development of an integrated monitoring plan
   e. Patient counseling

4. Which one of the following is *not* a step involved in the identification of patient problems?
   a. Identification of subjective and objective patient data
   b. Creation of a working list of all patient data
   c. Prioritization of patient data
   d. Creation of sets of related problems
   e. Determination of each specific patient problem
5. Which one of the following is a subjective parameter?
   a. Serum creatinine level
   b. Weight
   c. Height
   d. Dysuria
   e. Peak expiratory flow rate
6. Which one of the following is *not* a subjective parameter?
   a. Anxiety
   b. Indigestion
   c. Respiratory rate
   d. Insomnia
   e. Pain
7. Which one of the following is an objective parameter?
   a. Blurred vision
   b. Temperature
   c. Headache
   d. Tinnitus
   e. Fatigue
8. Which one of the following is *not* an objective parameter?
   a. Vertigo
   b. Urine output
   c. Bilirubin level
   d. Hemoglobin level
   e. Ejection fraction
9. A patient arrives in the emergency room with a serious head injury. Laboratory tests identify mild hyperlipidemia. The patient is S/P hernia repair. Which of the following is an appropriate prioritization of the patient's problems?

	Problem No. 1	Problem No. 2	Problem No. 3
a.	Head injury	Hyperlipidemia	S/P hernia repair
b.	S/P hernia repair	Hyperlipidemia	Head injury
c.	Hyperlipidemia	S/P hernia repair	Head injury
d.	Hyperlipidemia	Head injury	S/P hernia repair
e.	Head injury	S/P hernia repair	Hyperlipidemia

10. A patient arrives at the medication refill clinic requesting a refill of her antihypertensive medication. She states that "it is hard to get around because my feet have been so swollen." Physical examination reveals bilateral 4+ pitting edema of the knees, scattered crackles in all lung fields, jugular venous distention, and a displaced point of maximal impulse. Blood pressure is 120/78 mm Hg. She has a penicillin allergy. Which of the following is an appropriate prioritization of the patient's problems?

	Problem No. 1	Problem No. 2	Problem No. 3
a.	Hypertension	Penicillin allergy	Congestive heart failure
b.	Hypertension	Congestive heart failure	Penicillin allergy
c.	Congestive heart failure	Hypertension	Penicillin allergy
d.	Congestive heart failure	Penicillin allergy	Hypertension
e.	Penicillin allergy	Congestive heart failure	Hypertension

11. Which of the following is *not* a step in the selection of specific therapeutic regimens?
    a. Creation of a list of therapeutic options for each problem
    b. Selection of an appropriate therapeutic regimen for each problem
    c. Identification of alternative regimens
    d. Creation of a monitoring plan and monitoring of patient response to treatment
    e. Identification of objective and subjective patient parameters
12. A patient with a dry, hacking cough asks the pharmacist to recommend a cough medication. The pharmacist, who does not know the patient, recommends a popular nonprescription cough suppressant without checking the patient's medication profile. What error did the pharmacist commit?
    a. The pharmacist should have considered other patient problems.
    b. The pharmacist should have recommended an expectorant.
    c. The pharmacist should have advised the patient to see a physician.
    d. The pharmacist should have recommended a decongestant.
    e. The pharmacist should have obtained a prescription for a cough suppressant from the patient's doctor.

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Audio glossary terms

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CHAPTER

8 Monitoring Drug Therapies

LEARNING OBJECTIVES

- Identify the skills needed to monitor patient drug therapy.
- List and describe each step in the monitoring process.
- Identify the four types of monitoring data included in the four-square monitoring method.
- Given specific monitoring parameters, organize patient data appropriately.

Patient-focused care is a continuous cycle of data acquisition and assessment, problem identification and prioritization, therapeutic planning, and patient monitoring (Figure 8-1). Monitoring, an important component of the SOAP (*S*ubjective, *O*bjective, *A*ssessment, *P*lan)–based planning process (Box 8-1), consists of identifying, measuring, and assessing patient-specific outcome parameters. Monitoring specific patient outcomes provides clinicians with the information needed to determine whether the nondrug and drug interventions achieve the goals of therapy or whether the interventions need to be changed. Monitoring also provides the data for justifying and documenting why change is necessary (e.g., inadequate response, disease progression, patient dissatisfaction, drug allergy, drug interactions, or undesirable or potentially dangerous adverse drug reactions).

Expertise in a variety of skills (e.g., communication skills, physical assessment skills) and excellent pharmacotherapy and human disease knowledge are required to monitor patients. Pharmacists in institutional patient care facilities such as acute care hospitals or long-term care facilities have multiple opportunities to interact with patients and have access to extensive patient-specific laboratory and diagnostic data. Pharmacists in community pharmacy settings such as community pharmacies or outpatient clinics interact with patients through multiple but brief patient encounters over prolonged periods of time. Access to objective patient data in the community pharmacy setting currently is limited but is expected to increase as access to patient databases expands with advances in technology. In the not too distant future, patients may carry their complete records on small computer chips embedded on credit card–sized plastic cards accessible by all health care professionals in all patient care settings.

All pharmacists, regardless of the patient care setting or available technology, can obtain a significant amount of monitoring data through direct patient questioning and close observation of the patient. Routine physical examination procedures such as measurement of blood pressure, heart rate, and respiratory rate; assessment of lung sounds; and foot examination for diabetic patients are already being performed in some community pharmacies as part of medication therapy management (MTM) practices. Some pharmacists perform more comprehensive physical examinations (e.g., neurologic examination, funduscopic examination) as they monitor more complex therapeutic regimens. Data from these routine assessments provide important patient monitoring information with minimal equipment or patient invasiveness.

The amount of available patient data can be extensive. For example, ambulatory patients may self-monitor blood pressure, blood glucose, or peak expiratory flow rate several times a day. In some acute patient care settings (e.g., intensive care units), the patient's blood pressure, heart rate, respiratory rate, arterial oxygen saturation, and electrical activity of the heart are monitored continuously. It is impossible to collect, organize, and assess such large quantities of data. Fortunately, monitoring is a selective, targeted process; it is not necessary to obtain and assess every possible piece of patient data. Monitoring consists of selecting and assessing specific data related to selected target outcomes. This chapter introduces a structured process and approach to monitoring patient response to drug therapy.

PROCESS

Monitoring is an organized, structured, and dynamic process (Box 8-2). The initial monitoring plan, developed when the initial nondrug and drug intervention plan is created, is repeatedly revised according to patient response and subsequent changes in the intervention

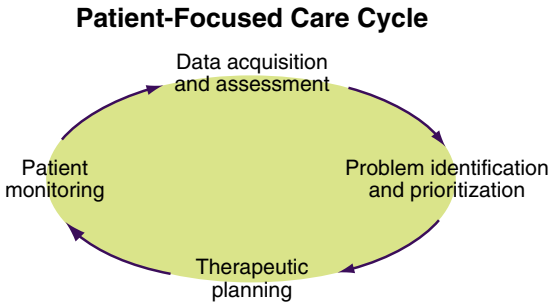

Figure 8-1 **Patient-Focused Care Cycle.**

Box 8-1 The SOAP-Based Planning Process

1. Identify the problems
2. Prioritize the problems
3. Select patient-specific drug and nondrug interventions
4. Develop a monitoring plan

SOAP, *S*ubjective, *O*bjective, *A*ssessment, *P*lan.

plan. For example, patients who begin antihypertensive drug therapy initially require frequent monitoring (i.e., every 2 to 4 weeks) to assess the response to the drug therapy. The drug dose often needs to be titrated up or other medications need to be added to the regimen to achieve the target blood pressure. Once the target blood pressure is achieved and the patient's condition is stable, the frequency of monitoring can be extended (i.e., every 6 to 12 months). Patients who begin oral anticoagulation therapy initially require weekly monitoring; the monitoring intervals are extended once the patient's therapeutic regimen provides a stable and predictable therapeutic response.

The monitoring plan includes the monitoring intervals for each monitoring parameter. Monitoring intervals depend on what the specific target outcome is and how quickly or slowly the target outcome is expected to be achieved; what the pharmacokinetic properties (absorption, distribution, metabolism, elimination) of the medication are; and how long it takes for a potential adverse drug effect to appear. For example, the level of glycosylated hemoglobin (Hb A_{1C}) changes slowly in response to long-term glucose control and is routinely monitored every 6 to 12 months. It may take several weeks for changes associated with pneumonia to resolve; repeating chest radiography within a few days of starting a course of antibiotics is not appropriate unless the patient has signs and symptoms consistent with progressive pneumonia. Drug-associated anaphylaxis typically occurs within minutes to hours of the first dose; ambulatory patients may be observed closely for a few hours after receiving the first dose then sent home with instructions to contact the prescriber if symptoms develop. Isoniazid-associated hepatotoxicity develops slowly with continued exposure to the drug; liver function tests are performed before starting therapy to obtain a baseline and then repeated monthly during the 6-month course of therapy. Chemotherapy-associated neutropenia occurs quickly and predictably; the complete blood count and differential are monitored daily to identify if and when preventive interventions (i.e., isolation, antibiotic prophylaxis) are indicated. It takes about 10 days for phenytoin to reach steady state after therapy is initiated or the dose is changed; non–steady-state drug serum concentrations may be misleadingly low and should not be used as the basis for routine dosage adjustments. When developing the monitoring plan, consider how long it takes for the expected therapeutic response to appear and the time course for the development of adverse drug effects. Some adverse drug effects are idiosyncratic and appear without warning; patients need to report any new or unusual effects.

Box 8-2 The Monitoring Process

Step 1—Determine specific monitoring parameters
- Select specific target outcomes
- Select monitoring intervals for each parameter

Step 2—Integrate the monitoring plan
Step 3—Obtain data
Step 4—Assess the response to therapy

The monitoring plan must be thorough and complete, yet practical given the patient setting and relative risks and benefits of the intervention. It is not possible to monitor for every adverse effect documented for every drug; many clinicians monitor patients closely for adverse effects that are reported to occur at a rate of 10% or higher or are less common but potentially life-threatening. For example, monitoring for rare potential adverse drug effects identifiable only on the electrocardiogram is reasonable for a critically ill patient already undergoing continuous electrocardiographic monitoring but not a viable option for an ambulatory patient with no signs or symptoms of drug-associated cardiotoxicity. However, documenting the baseline electrocardiographic findings and then periodically recording an electrocardiogram is a reasonable approach for drugs with known but uncommon potentially serious cardiovascular toxicities. It is also not possible to specifically monitor for idiosyncratic or previously unidentified adverse drug effects. The pharmacist must be aware of the possibility of these types of potential adverse drug effects and solicit and assess all patient complaints (e.g., ask the patient if he or she has experienced anything unusual since starting the medication).

STEP 1—DETERMINE SPECIFIC MONITORING PARAMETERS

All medication regimens have two possible outcomes:
1. The medication regimen provides the expected therapeutic benefit for the patient.
2. The medication regimen does not provide the expected therapeutic benefit or is otherwise harmful to the patient.

Each outcome is assessed by questioning the patient to elicit subjective data and by obtaining quantifiable objective data, so that four distinct types of monitoring data can be collected:
1. *Subjective-therapeutic*—subjective data for assessing whether the medication regimen provides the expected therapeutic outcome
2. *Subjective-toxic*—subjective data for assessing whether the medication regimen does not provide the expected

Figure 8-2 Organization of Monitoring Parameters (the Four-Square Method). Subjective-therapeutic monitoring parameters are subjective measures indicating that the expected therapeutic outcome has occurred. Subjective-toxic monitoring parameters are subjective measures indicating therapeutic failure or harm to the patient. Objective-therapeutic monitoring parameters are objective measures indicating that the expected therapeutic outcome has occurred. Objective-toxic monitoring parameters are objective measures indicating therapeutic failure or harm to the patient.

therapeutic outcome or is otherwise harmful to the patient

3. *Objective-therapeutic*—objective data for assessing whether the medication regimen provides the expected therapeutic outcome
4. *Objective-toxic*—objective data for assessing whether the medication regimen does not provide the expected therapeutic outcome or is otherwise harmful to the patient

Visualize the four sets of monitoring data as four subdivisions of a large square (the four-square method) (Figure 8-2). Each subdivision represents one of the four types of monitoring data (i.e., subjective-therapeutic, subjective-toxic, objective-therapeutic, and objective-toxic); the large square represents the complete monitoring plan. The four-square method is used to create drug-specific monitoring plans (i.e., one large square is completed for each drug in a patient's medication regimen) or to create an integrated monitoring plan encompassing all the drugs in the patient's therapeutic regimen (i.e., data from multiple drug-specific four-squares are combined into one large integrated square).

Subjective-Therapeutic Monitoring Parameters

Consider the patient's symptoms and determine the expected outcome if the drug therapy is successful (e.g., decreased pain, increased exercise tolerance, less shortness of breath with exertion). If the intervention produces the expected target response, the abnormalities will return to normal or at least approach acceptable outcomes.

Subjective-Toxic Monitoring Parameters

Patient symptoms will persist or even worsen if the medication does not achieve the expected target outcome. Identify current patient symptoms and determine the outcome if the drug therapy is not successful (e.g., increased pain, decreased exercise tolerance, increased shortness of breath with exertion). If the intervention fails to produce the expected target response, the abnormal monitoring parameters will remain abnormal.

Subjective-toxic monitoring parameters also include monitoring parameters for adverse drug effects (side effects). Consider the potential adverse effects attributed to the specific medication and develop a list of questions to ask the patient to identify the presence of the adverse drug effects. For example, theophylline irritates the stomach and stimulates the heart. It would be appropriate to ask the patient if the theophylline irritates his or her stomach or causes nausea and whether he or she has felt a faster than usual heartbeat. The pharmacist needs to be careful to avoid questions that are leading questions or questions that confuse the patient. For example, not all patients get drowsy when taking antihistamines. A patient asked repeatedly if his or her antihistamine makes the patient drowsy may think that the drug is not working because it does cause drowsiness.

Objective-Therapeutic Monitoring Parameters

Identify current abnormal objective data and determine the target response (e.g., weight loss of 1 to 2 lb/wk, 15% increase in forced expiratory volume in 1 second [FEV_1], decrease in heart rate to >50 beats per minute but <80 beats/min). If the intervention produces the expected target response, the abnormal values will return to normal or at least approach acceptable outcomes.

Objective-Toxic Monitoring Parameters

Identify current abnormal objective data and determine the outcome if the intervention does not achieve the target outcome (e.g., the patient fails to lose the target weight or gains weight, the FEV_1 remains the same or decreases, the heart rate is ≤50 beats/min or ≥80 beats/min). If the intervention fails to produce the expected target response, the abnormal monitoring parameters will remain abnormal.

Objective-toxic monitoring parameters also include monitoring parameters for adverse drug effects (side effects). Consider the potential adverse effects attributed to the specific medication and develop a list of objective data that need to be obtained to identify the presence of the adverse drug effects. The adverse effect itself is not necessarily the specific parameter that needs to be monitored. The pharmacist needs to consider the reported adverse effects and determine how to identify the adverse effect should it occur. For example, thrombocytopenia is a side effect associated with heparin therapy. *Thrombocytopenia* literally means "decreased platelets" and is not an appropriate monitoring parameter because it is too imprecise a term. The appropriate monitoring parameter is the platelet count, with a count of less than 100,000 cells/mm^3 indicating the adverse effect of thrombocytopenia. This is a specific, precise, and easily identified criterion outcome.

When developing the monitoring plan, select appropriate subjective and objective monitoring parameters and record the monitoring parameters in the appropriate subdivision of the large square; complete a four-square

for each medication in the therapeutic regimen. This approach not only produces an organized and thorough monitoring plan but also provides a reminder of the relationships among the types of monitoring data and the reasons for evaluating specific parameters. Experienced clinicians work through this planning process mentally; students and less experienced clinicians may find writing down each step a useful exercise as they develop comprehensive monitoring plans.

Example: Select appropriate subjective-therapeutic, subjective-toxic, objective-therapeutic, and objective-toxic monitoring parameters for a 25-year-old patient with a severe ankle sprain for which ibuprofen 600 mg every 8 hours is prescribed. The patient has no other medical conditions. Her symptoms include throbbing pain that keeps her awake at night. Ibuprofen is approved by the Food and Drug Administration (FDA) for the treatment of inflammatory disorders, including mild to moderate pain. Documented adverse effects and incidents reported for ibuprofen include edema (3% to 9%), rash (3% to 9%), epigastric pain (3% to 9%), heartburn (3% to 9%), nausea (3% to 9%), tinnitus (3% to 9%), headache (1% to 3%), nervousness (1% to 3%), itching (1% to 3%), abdominal pain or cramps (1% to 3%), decreased appetite (1% to 3%), constipation (1% to 3%), diarrhea (1% to 3%), flatulence (1% to 3%), and a very long list of adverse effects with a reported incidence of less than 1%, including acute renal failure, agranulocytosis, anaphylaxis, aplastic anemia, gastrointestinal bleeding, hallucinations, inhibition of platelet aggregation, abnormal liver function test results, leukopenia, pancreatitis, thrombocytopenia, and toxic epidermal necrolysis.

***Subjective-therapeutic monitoring parameters:** It is reasonable to expect that the ibuprofen will reduce the pain, although it will not necessarily decrease the pain enough to allow the patient to sleep through the night. Therefore, the subjective-therapeutic monitoring target outcomes include decreased pain and sleeping through the night. These monitoring outcomes can be assessed by asking the patient how well the ibuprofen works to reduce her pain and whether the pain is reduced enough to let her sleep through the night.*

***Subjective-toxic monitoring parameters:** Failure of the ibuprofen to achieve the expected therapeutic outcome is recognized by the presence of persistent throbbing pain that prevents the patient from sleeping through the night. These monitoring outcomes can be assessed by asking the patient how well the ibuprofen works to reduce her pain and whether the pain is reduced enough to let her sleep through the night. A reasonable monitoring strategy for potential drug-associated adverse effects in this ambulatory patient with no other medical conditions would be to ask her if the ibuprofen upsets her stomach or causes heartburn, nausea, ankle swelling, itching or a rash, or ringing in the ears. Less common side effects such as pancreatitis would not be routinely monitored for but would be identified if the patient reported new symptoms.*

***Objective-therapeutic parameters:** There are no reasonably available objective data for assessing the beneficial effects of ibuprofen for this patient. Daily imaging studies (e.g., magnetic resonance imaging [MRI]) might identify measurable reduction in swelling, which might be associated with less pain, but would be exceedingly expensive and completely unjustifiable for this patient.*

***Objective-toxic parameters:** There are no reasonably available objective data for assessing the lack of benefit of ibuprofen for this patient. Most of the adverse effects documented for ibuprofen that are identifiable with objective data occur at an incidence of less than 1% and require invasive tests that would add significant cost to the care of the patient if routinely monitored for. Thus, it would not be reasonable to monitor the patient's complete blood count, liver function test results, or serum creatinine level unless the patient was at increased risk for, or was experiencing, adverse effects.*

The patient does not require follow-up with the prescriber unless the ibuprofen fails to control the pain or the patient develops any of the potential adverse drug effects. The patient should be instructed to contact the prescriber if the ibuprofen does not control the pain within a couple of days or if the ibuprofen upsets her stomach or if she experiences heartburn, nausea, ankle swelling, itching or a rash, or ringing in the ears or notices anything else unusual after starting the ibuprofen.

STEP 2—INTEGRATE THE MONITORING PLAN

No integration is required if the patient is receiving just one medication. However, most patients receive multiple drugs; therefore the individual medication monitoring plans must be integrated into one master monitoring plan. One way to integrate the monitoring plan is to create a master list of subjective and objective monitoring parameters collated from each of the individual medication monitoring plans, noting all the reasons for monitoring any given parameter. For example, heart rate may be an objective monitoring parameter for the therapeutic and toxic response to digoxin, the therapeutic response to procainamide, and the toxic response to theophylline. To monitor the heart rate, the pharmacist needs to measure the heart rate only once; however, the monitoring plan documents all the reasons why the heart rate is being monitored.

STEP 3—OBTAIN DATA

Once the monitoring plan is created, monitor the patient's response to therapy at the predetermined monitoring intervals. Interview the patient or caregiver for subjective data. Obtain objective data from the patient's medical record, bedside flow sheets, and laboratory reports. Document the data.

Document the monitoring data in organized, easily assessable formats. Flow sheets work well for documenting large amounts of objective data; brief sequential notes work well for documenting subjective data. Many pharmacists prefer to create their own customized monitoring forms or computer files that provide a structured format to organize the types of data they routinely monitor in their practice settings. Some pharmacists use institution-specific monitoring forms or computer files that have been developed and agreed on by consensus. Figures 8-3 and 8-4 are examples of medication flow sheets, and Figures 8-5 through 8-7 are examples of objective data flow sheets. Some pharmacists prefer to use commercial patient tracking software available via smart phones, personal data assistants (PDAs), or wireless computer technologies. Because of the increasing availability of wireless Internet access and small portable handheld computers,

SCHEDULED MEDICATIONS

Patient:		**ID Number:**	**Physician:**
Drug Allergies/Adverse Reactions:			
Diagnosis:			
Start	Stop	Medication Dose, Route, Schedule	

Figure 8-3 Scheduled Medications Flow Sheet.

PRN MEDICATIONS

Patient:		**ID Number:**	**Physician:**
Drug Allergies/Adverse Reactions:			
Diagnosis:			
Start	Stop	Medication Dose, Route, Schedule	

Figure 8-4 As-Needed (PRN) Medications Flow Sheet.

	Time and Date
Sodium	
Potassium	
Chloride	
CO_2 content	
BUN	
Creatinine	
Glucose	
Calcium	
Magnesium	
Phosphorus	
Uric acid	
Bilirubin, total	
Bilirubin, direct	
Bilirubin, delta	
Protein, total	
Albumin	
Globulin	
LDH	
AST	
ALT	
AP	
CPK	
Amylase	
Ammonia	
RBCs	
Reticulocytes	
Hemoglobin	
Hematocrit	
ESR	
WBCs	
PMNs	
Bands	
Lymphocytes	
Eosinophils	
Other	
Platelets	
PT/INR	
PTT	
ABG	
FIo_2	
pH	
$Paco_2$	
Pao_2	
Bicarbonate	
Base excess	
Sao_2	

Figure 8-5 Laboratory Flow Sheets.

	Time and Date
Blood Pressure	
Heart Rate	
Cardiac Output	
Cardiac Index	
MAP	
RAP	
RVP	
RVP, systolic	
RVP, diastolic	
PAP, mean	
PAP, systolic	
PAP, diastolic	
PAOP, mean	
SVR	
PVR	
Cao_2	
Cvo_2	

Figure 8-6 Hemodynamics Flow Sheet.

many pharmacists document all patient monitoring data electronically.

STEP 4—ASSESS THE RESPONSE TO THERAPY

Assess the subjective and objective data to determine the patient's response to therapy. Look for isolated abnormalities as well as trends. Recognizing trends is as important as recognizing individual abnormalities. For example, a slowly decreasing serum platelet count is as important as a single hypoglycemic reaction to a larger-than-necessary dose of insulin. A slowly rising serum creatinine level should trigger a review for potential drug nephrotoxicity as well as consideration of all drug dosages.

There is no need to change the therapeutic regimen if the medication regimen achieves the desired outcomes. However, the therapeutic regimen must be changed if it does not achieve the desired therapeutic outcome or if it is associated with intolerable or potentially dangerous adverse effects (Box 8-3). Dosages may be increased or decreased; drugs may be deleted or added to the regimen. Make the appropriate changes to the therapeutic regimen, modify the monitoring plan, and continue the patient-focused care cycle.

APPLICATION AND INTEGRATION

The case study on pages 9-11 illustrates the patient-focused care cycle.

Case Study

Jack Campbell, a 69-year-old white male with a diagnosis of right- and left-sided congestive heart failure, complains of swollen feet, shortness of breath when walking more than half a block, nonproductive cough that is worse at night, and occasional leg cramps. He has gained 30 lb over the past 3 months and notes that all his clothes are too tight. He props himself up with three pillows when sleeping. The goal of therapy is to improve the patient's quality of life by improving cardiac function and controlling symptoms. His new medication regimen includes digoxin (Lanoxin) 0.25 mg daily, furosemide (Lasix) 40 mg daily, captopril (Capoten) 25 mg three times daily, and potassium chloride (Slow-K) 8 mEq three times daily.

Digoxin Monitoring Parameters (Figure 8-8)

Subjective-therapeutic monitoring parameters—The patient's symptoms will diminish or resolve if digoxin therapy provides the expected therapeutic benefit of improved cardiac function.

Subjective-toxic monitoring parameters—The patient's symptoms will not improve and may worsen if digoxin therapy does not provide the expected therapeutic benefit. The patient also may experience a variety of annoying or potentially harmful side effects from digoxin therapy.

Objective-therapeutic monitoring parameters—A variety of laboratory and other tests are used to monitor improvement in cardiac function. Improved cardiac function may not be immediately evident after initiation of treatment but may be apparent with long-term drug therapy.

Objective-toxic monitoring parameters—A variety of laboratory and other tests are used to monitor for lack of improvement in cardiac function or potentially harmful side effects from digoxin therapy.

Furosemide Monitoring Parameters (Figure 8-9)

Subjective-therapeutic monitoring parameters—The patient's symptoms will decrease or resolve if furosemide therapy improves cardiac function by decreasing intravascular volume.

Subjective-toxic monitoring parameters—The patient's symptoms will not improve and may worsen if furosemide therapy does not provide the expected therapeutic benefit. The patient also may experience a variety of annoying or potentially harmful side effects from furosemide therapy.

Objective-therapeutic monitoring parameters—A variety of laboratory and other tests are used to monitor improvement in the fluid overload status of the patient. Some improvement in cardiac function may occur as a result of diuretic therapy.

Objective-toxic monitoring parameters—A variety of laboratory and other tests are used to monitor for lack of improvement in cardiac function or potentially harmful side effects from furosemide therapy.

Captopril Monitoring Parameters (Figure 8-10)

Subjective-therapeutic monitoring parameters—The patient's symptoms will decrease or resolve if captopril therapy provides the expected therapeutic benefit of improved cardiac function.

Subjective-toxic monitoring parameters—The patient's symptoms will not improve and may worsen if captopril therapy does not provide the expected therapeutic benefit. The patient also may experience a variety of annoying or potentially harmful side effects from captopril therapy.

Objective-therapeutic monitoring parameters—A variety of laboratory and other tests are used to monitor improvement in cardiac function. Improvement in cardiac function may not be immediately evident after initiation of treatment but may be noted after long-term drug administration.

Objective-toxic monitoring parameters—A variety of laboratory and other tests are used to monitor for lack of improvement in cardiac function or potentially harmful side effects from captopril therapy.

Potassium Chloride Monitoring Parameters (Figure 8-11)

Subjective-therapeutic monitoring parameters—The patient is receiving supplemental potassium to prevent hypokalemia resulting from the furosemide therapy. Because this is preventive therapy, no subjective parameters are available to evaluate the desired outcome of supplemental potassium therapy.

Subjective-toxic monitoring parameters—The patient may develop symptoms of hypokalemia if potassium supplementation is inadequate. Conversely, if potassium supplementation is excessive, the patient may experience symptoms of hyperkalemia.

Objective-therapeutic monitoring parameters—The goal of therapy is to maintain an appropriate serum potassium level with supplemental therapy.

Objective-toxic monitoring parameters—Objective monitoring parameters for supplemental potassium therapy are limited.

Integrated Monitoring Plan

The integrated subjective parameters monitoring plan is shown in Box 8-4. The integrated objective parameters monitoring plan is shown in Box 8-5. The drugs in the therapeutic regimen are prescribed for the management of congestive heart failure. Therefore a great deal of duplication occurs among the monitoring plans. However, the pharmacist needs to know the multiple reasons for monitoring each parameter. For example, blood pressure is an important therapeutic and toxic monitoring parameter for several of the drugs in the medication regimen.

Monitor the patient frequently (e.g., weekly) for initial response to therapy, then less frequently (e.g., every 6 months) as the patient's condition stabilizes. The patient should weigh himself daily and contact the prescriber if he has gained more than 1.0 to 1.5 lb. The serum potassium concentration and renal function should be assessed 1 to 2 weeks after changing the dose of the captopril or potassium. The serum digoxin concentration should be assessed 1 to 2 weeks after changing the dose and at least annually if the patient's condition is stable. Therapeutic monitoring is an ongoing process. Modify the therapeutic regimen and monitoring plan according to the patient's response.

Date	Site	Gram's Stain	Organism(s)	Susceptibilities	
				Sensitive	Resistant

Figure 8-7 **Microbiology Flow Sheet.**

Box 8-3 Guidelines for Altering Drug Therapy

- If the regimen is ineffective, change the drug if:
  1. The patient received an adequate trial of the drug.
  2. The patient received an adequate dosage of the drug.
  3. The patient adhered to the prescribed or recommended regimen.
- If the regimen is associated with life-threatening side effects, discontinue the drug.
- If the patient will not adhere to the prescribed or recommended regimen because of unacceptable side effects, discontinue the drug.
- If the regimen is effective but the patient has non–life-threatening side effects and is willing to continue the drug, minimize the side effects:
  1. Modify the dosage.
  2. Change the drug administration time.
- If the regimen is effective and the patient has no drug-associated side effects, continue the current regimen.

Subjective-Therapeutic	Objective-Therapeutic
↓ Swelling of feet Looser-fitting clothing ↓ SOB and DOE ↑ Exercise tolerance Sleeps with fewer pillows ↓ Cough	↓ Heart size on CXR ↓ Edema on CXR ↓ Weight ↑ Ejection fraction Improved R-wave progression Normalization of R-S ↓ T-wave inversion
Subjective-Toxic	**Objective-Toxic**
↑ Swelling of feet Tighter-fitting clothing ↑ SOB and DOE ↓ Exercise tolerance More problems sleeping ↑ Cough ↓ Appetite Nausea Vomiting Halos around lights Yellowish visual tinting Abdominal discomfort Palpitations Weakness Lethargy Agitation or disorientation	↑ Heart size on CXR ↑ Edema on CXR ↑ Weight ↓ Ejection fraction Poor R-wave progression Abnormal R-S ↑ T-wave inversion VPDs Cardiac arrhythmias Serum digoxin >2 ng/ml ↓ Heart rate <50 BPM ↓ SBP <100 mm Hg ↓ DBP <60 mm Hg

Figure 8-8 **Digoxin Monitoring Plan.** Examples of subjective and objective monitoring parameters for digoxin.

Subjective-Therapeutic	Objective-Therapeutic
↓ Swelling of feet Looser-fitting clothing ↓ SOB and DOE Able to sleep with fewer pillows ↓ Cough	↓ Heart size on CXR ↓ Edema on CXR ↓ Weight ↑ Ejection fraction Improved R-wave progression Normalization of R-S ↓ T-wave inversion
Subjective-Toxic	**Objective-Toxic**
↑ Swelling of feet Tighter-fitting clothing ↑ SOB and DOE More problems sleeping ↑ Cough Muscle cramps Dry mouth Thirst Dizziness Upset stomach Weakness Palpitations Lethargy Confusion	↑ Heart size on CXR ↑ Edema on CXR ↑ Weight ↓ Ejection fraction Poor R-wave progression Abnormal R-S ↑ T-wave inversion ↓ Serum potassium ↑ Serum glucose ↑ Serum uric acid ↑ Serum BUN/creatinine ratio ↑ Serum BUN ↑ Serum creatinine ↓ Blood pressure ↑ Heart rate U wave or flattened T wave

Figure 8-9 **Furosemide Monitoring Plan.** Examples of subjective and objective monitoring parameters for furosemide.

Subjective-Therapeutic	Objective-Therapeutic
↓ Swelling of feet Looser-fitting clothing ↓ SOB and DOE ↑ Exercise tolerance Able to sleep with fewer pillows ↓ Cough	↓ Heart size on CXR ↓ Edema on CXR ↓ Weight ↑ Ejection fraction Improved R-wave progression Normalization of R-S ↓ T-wave inversion
Subjective-Toxic	**Objective-Toxic**
↑ Swelling of feet Tighter-fitting clothing ↑ SOB and DOE ↓ Exercise tolerance More problems sleeping Persistent dry cough Dizziness Itching Maculopapular or morbilli- -form rash Dysgeusia	↑ Heart size on CXR ↑ Edema on CXR ↑ Weight ↓ Ejection fraction Poor R-wave progression Abnormal R-S ↑ T-wave inversion Elevated temperature Eosinophilia Proteinuria ↑ Serum creatinine ↑ Serum BUN ↓ Blood pressure WBC with differential

Figure 8-10 Captopril Monitoring Plan. Examples of subjective and objective monitoring parameters for captopril.

Subjective-Therapeutic	Objective-Therapeutic
None.	Serum potassium 3.5-5 mEq/L
Subjective-Toxic	**Objective-Toxic**
Nausea Vomiting Diarrhea Bad taste Abdominal discomfort Palpitations Lethargy Weakness Muscle cramps	Serum potassium <3.5 mEq/L Flattened T wave Widened Q-R-S complex Peaked T waves Flattened or inverted T waves U waves

Figure 8-11 Potassium Chloride Monitoring Plan. Examples of subjective and objective monitoring parameters for potassium chloride.

Box 8-4 Patient Case—Integrated Subjective Parameters Monitoring Plan

SUBJECTIVE-THERAPEUTIC MONITORING PARAMETERS

General: Looser-fitting clothing; able to sleep with fewer pillows
Chest and lungs: ↓ SOB and DOE; ↑ exercise tolerance; ↓ cough
Extremities: ↓ Swelling of feet

SUBJECTIVE-TOXIC MONITORING PARAMETERS

General: Tighter-fitting clothing; more problems sleeping; weakness; lethargy; agitation or disorientation; confusion; dizziness
Vision: Halos around lights; yellowish visual tint
Chest and lungs: ↑ SOB and DOE; ↓ exercise tolerance; ↑ cough, persistent dry cough
CV: Palpitations
Gastrointestinal: Dry mouth; thirst; ↓ appetite; nausea; vomiting; abdominal discomfort; upset stomach; diarrhea; dysgeusia
Extremities: ↑ Swelling of feet; muscle cramps
Skin: Itching; maculopapular or morbilliform rash

Box 8-5 Patient Case—Integrated Objective Parameters Monitoring Plan

OBJECTIVE-THERAPEUTIC MONITORING PARAMETERS

↓ Weight ≥ 1-2 lbs per week
CXR: ↓ Heart size; ↓ edema
↑ Ejection fraction ≥10%
ECG: Improved R-wave progression; normalization of S-R, ↓ T-wave inversion
Labs: Serum potassium 3.5-5.0 mEq/L

OBJECTIVE-TOXIC MONITORING PARAMETERS

↑ Weight ≥ 1-2 lbs per week
CXR: ↑ Heart size; ↑ edema
↓ Ejection fraction ≥10%
ECG: Poor R-wave progression; abnormal RS; ↑ T-wave inversion; VPDs; arrhythmias; U waves or flat or inverted T waves; flattened P waves; widened QRS complex; peaked T waves
Serum digoxin >2 ng/mL
Vital signs: HR <50 beats/min; HR >120 breaths/min; BP <100/60 mm Hg; T >100° F (37°C)
Labs: Serum potassium >5 mEq/L; serum potassium <3.5 mEq/L; serum uric acid >7 mg/dL; serum glucose >180 mg/dL ; serum BUN/creatinine ratio >20:1; serum BUN >20 mg/dL, serum creatinine >2 mg/dL, eosinophils >350/mm^3; proteinuria; WBCs <5000/mm^3

APPLICATION ACTIVITY

Working individually or in groups of three or four, develop a monitoring plan for the treatment of the iguana bite described in the patient case in the Chapter 7 Application Activities section (see page 143). Determine specific monitoring parameters for all four types of monitoring data (subjective-therapeutic, subjective-toxic, objective-therapeutic, objective-toxic). Select specific target outcomes and monitoring intervals for each monitoring parameter.

SELF-ASSESSMENT QUESTIONS

1. Monitoring a patient's response to drug therapy requires which of the following?
   a. Knowledge of pharmacotherapeutics
   b. Knowledge of pathophysiology
   c. Communication skills
   d. Physical assessment skills
   e. All of the above
2. Which of the following is the *first* step in the monitoring process?
   a. Monitoring the response to therapy
   b. Assessing the response to therapy
   c. Setting therapeutic goals
   d. Integrating the monitoring plan
   e. Determining specific monitoring parameters
3. Which of the following is the *last* step in the monitoring process?
   a. Monitoring the response to therapy
   b. Assessing the response to therapy
   c. Setting therapeutic goals
   d. Integrating the monitoring plan
   e. Determining specific monitoring parameters
4. For what kind of patient is the availability of monitoring data limited?
   a. A hospitalized, critically ill patient
   b. A patient who just started insulin therapy
   c. A patient with stable, well-controlled mild hypertension
   d. A patient undergoing renal dialysis
   e. A postsurgical trauma patient
5. For which kind of patient is the largest amount of monitoring data available?
   a. A hospitalized, critically ill patient
   b. A patient who just started insulin therapy
   c. A patient with stable, well-controlled mild hypertension
   d. A patient undergoing renal dialysis
   e. A postsurgical trauma patient
6. A patient is receiving a medication associated with hypokalemia (potassium reference range = 3.5 to 5.5 mEq/L). Which of the following is an appropriate therapeutic goal when monitoring potassium replacement therapy?
   a. Serum potassium level of 4.0 mEq/L
   b. Serum potassium level of more than 5.5 mEq/L
   c. Serum potassium level of less than 3.5 mEq/L
   d. Serum potassium level of 3.5 to 5.5 mEq/L
   e. Serum potassium level of 2.0 to 3.0 mEq/L

Refer to the following information for questions 7 through 10: A patient with pneumonia is receiving an antibiotic for the treatment of acute bronchitis. The patient's symptoms include cough and fever. The antibiotic may cause diarrhea and thrombocytopenia.

7. *Decreased cough* is what type of monitoring parameter?
   a. Subjective-therapeutic
   b. Subjective-toxic
   c. Objective-therapeutic
   d. Objective-toxic
   e. None of the above
8. *Decreased fever* is what type of monitoring parameter?
   a. Subjective-therapeutic
   b. Subjective-toxic
   c. Objective-therapeutic
   d. Objective-toxic
   e. None of the above
9. *Diarrhea* is what type of monitoring parameter?
   a. Subjective-therapeutic
   b. Subjective-toxic
   c. Objective-therapeutic
   d. Objective-toxic
   e. None of the above
10. *Thrombocytopenia* is what type of monitoring parameter?
    a. Subjective-therapeutic
    b. Subjective-toxic
    c. Objective-therapeutic
    d. Objective-toxic
    e. None of the above
11. An ambulatory patient is started on antihypertensive drug therapy for newly diagnosed hypertension. When should the patient return to the clinic for assessment of his blood pressure?
    a. One day
    b. Two weeks
    c. Six months
    d. One year
    e. Three years
12. An ambulatory patient is started on oral pain medication for a fractured arm. The patient has no other medical conditions. The medication causes drowsiness in 40% to 50% of patients who take the drug. Rare side effects (<1%) include thrombocytopenia, acute renal failure, and hepatitis. Weight gain has been reported with long-term use. Which of the following is an appropriate monitoring parameter for this patient?
    a. Weight
    b. Serum creatinine level
    c. Drowsiness
    d. Serum alanine aminotransferase level
    e. Platelet count

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Audio glossary terms

CHAPTER

9 Researching and Providing Drug Information

LEARNING OBJECTIVES

- Identify the components involved in providing drug information to health care professionals and patients.
- Identify and categorize common types of drug information questions.
- List examples of questions used to clarify the initial drug information question.
- State the key to a successful search of the published literature.
- Differentiate among primary, secondary, and tertiary literature.
- State how to evaluate primary, secondary, and tertiary literature.
- Describe how to access information in textbooks, in files using the American Hospital Formulary Service numbering system, in computerized databases, and on the Internet.
- List the advantages and disadvantages of using the Internet to access drug information.
- State how to evaluate Internet drug information websites.
- Describe the best way to communicate answers to drug information questions.

Dissemination of information regarding medications and other pharmaceuticals is an important responsibility. Patients, physicians, nurses, and other health care professionals depend on pharmacists for accurate and timely information about medications. Pharmacists commonly answer questions about drug dosing, product availability, and drug side effects, as well as a variety of other drug-related issues (Box 9-1).

To respond effectively to drug information questions, pharmacists need good communication skills, knowledge of literature resources and ways to access them, and the ability to evaluate published information. Some questions (e.g., the usual adult dose of acetaminophen) can be answered by relying on previously acquired knowledge; other questions (e.g., the off-label use of metformin hydrochloride for the treatment of polycystic ovary syndrome) require a search and assessment of the published medical and pharmacy literature.

PROCESS

The components involved in the provision of drug information include determining the primary question, developing an appropriate search strategy, locating appropriate sources of information if the question cannot be answered from previously acquired knowledge, accessing the information, critically appraising the information, and providing a verbal or written response to the question.

DETERMINING THE PRIMARY QUESTION

Most questions arise as the result of a patient-specific problem; however, questions often are presented initially as broad-based theoretical issues. For example, a physician may ask for the incidence of allergic reactions to ceftriaxone when in fact the actual question is whether ceftriaxone is the cause of an otherwise unexplained neutropenia in a specific patient. Patients may have difficulty phrasing questions. For example, many patients do not understand the difference between an allergic response and an adverse reaction. Patients may ask about drug allergies when they really want to know whether the medication they are taking is the cause of a specific adverse effect such as nausea, constipation, headache, or drowsiness.

To determine the primary question, ask the person asking the question several clarifying questions. A good starting point is to ask whether the question pertains to a specific patient and, if so, to ask for pertinent background patient information. For example, if the question is about the possibility of an adverse reaction in a specific patient, inquire about the nature of the suspected problem and obtain details about the patient's current medication regimen, including drugs, dosages, and duration of therapy. Laboratory and physical examination findings also may be important pertinent details. Questions about therapeutic options may require even more information about the patient's diagnoses and past and current medication regimens.

Box 9-1 Types of Drug Information Questions

ADVERSE DRUG REACTIONS
Adverse reactions
Allergies
Teratogenicity
Toxicology

DOSING
Age-specific dosing
Dosing in patients with altered organ function (liver, kidneys)
Indication-specific dosing

DRUG ADMINISTRATION
Commercial dosage form alterations (crushing, dissolving)
Drug administration methods
Product preparation (reconstitution, admixing, compounding)
Compatibility, stability, and storage
Timing (with or without food or enteral products)

DRUG INTERACTIONS
Drug-disease interactions
Drug-drug interactions
Drug-food interactions
Drug–laboratory test interactions
Drug-nutrient interactions

INDICATIONS AND THERAPEUTIC USE
Approved drugs
Investigational drugs
Unapproved drugs

POISONINGS
Signs and symptoms
Treatment

PRODUCT-SPECIFIC CONCERNS
Constituents (sugars, dyes, adjuvants, alcohol)
Formulations
Identification
Storage

MISCELLANEOUS
Drug use during pregnancy and lactation
Pharmacoeconomics
Product-specific assays
Veterinary drug information

After the primary question and patient-specific details have been identified, rephrase and restate the question. Ask clarifying questions and exchange information until the primary question is agreed on and enough patient-specific information is known to allow a focused search for an answer. A chart review and/or direct patient interview may be necessary to locate all pertinent background information for the patient.

Determine when the answer is needed and how to contact the person who asked the question. Some questions require an immediate response for an urgent patient care decision; other questions are not as urgent and can be answered later the same day or even several days later. Do not assume that every question is urgent and has to be answered immediately at the expense of other responsibilities or, conversely, that every question can be put off to another day. Ask for the person's telephone or cell number or arrange to provide information face to face at a certain time and place, such as in the clinic the next afternoon or during patient rounds later that morning.

DEVELOPING AN APPROPRIATE SEARCH STRATEGY

Searching for drug information is a complex process that requires significant thought before action. A great deal of time can be wasted by searching for information in the wrong places or by searching on-line databases or the Internet using inappropriate search terms. Therefore formulate a strategy for locating the answer to the question before actually searching for the answer to the question.

The key to developing an appropriate search strategy is to think about the question and match the question with the most appropriate information sources. Questions of fact, such as dosage formulations, usual dosage regimens, dosage adjustments for patients with renal and hepatic dysfunction, pharmacokinetic parameters for drugs that have been marketed for several years, and spectrum of activity of marketed antibiotics, are best answered by looking up the information in standard drug information handbooks such as that published by the *American Hospital Formulary Service* (AHFS) or standard electronic databases such as *Micromedex*. Questions about investigational drugs, unapproved indications for currently marketed drugs, and unusual adverse effects and drug interactions are best answered by a thorough literature search of the published medical and pharmacy literature accessed through large literature databases such as MEDLINE or PubMed. MEDLINE is an online database containing approximately 18 million journal citations from about 5000 life sciences and biomedical publications from 1966 to the present.[1] The MEDLINE database, accessible by subscription interfaces, is compiled by the U.S. National Library of Medicine (NLM) and published on the Internet by the Community of Science (COS). PubMed, also a service of the NLM and the National Institutes of Health, is a freely accessible database accessible through the PubMed interface. PubMed contains more than 19 million journal citations published from 1949 to the present.[1]

The key to a successful search of the published literature is to identify appropriate search terms before starting the search. Terms can be identified by reading about the topic in a standard medical or pharmacy textbook or published review article or using indexing lists, such as the NLM's Medical Subject Headings (MeSH), used to index key terms for the MEDLINE database. These indexing terms are generally relevant for searches of any medical- or pharmacy-related database.

Flexibility is important when searching for information. If a search does not reveal any relevant information, it may be that there is no information to be found. However, most of the time the search strategy is faulty. For

example, the literature may not have been searched far enough back in time to locate older information or the search terms were not appropriate. Consider when information about a drug is most likely to have been published and try other related indexing terms before deciding that no information about the topic is available in the published literature.

LOCATING APPROPRIATE SOURCES OF INFORMATION

Drug information is available from a variety of sources. Primary, secondary, and tertiary literature are the mainstays of drug information. Other information sources include colleagues and pharmaceutical companies. Colleagues may be excellent sources of information; however, the information may be dated or incomplete and is ordinarily without reference. A pharmaceutical company may be a good source of information about company-specific drug-related issues. Information may be obtained by contacting the company's drug information center or product manager or by making a written inquiry. However, pharmaceutical companies provide information only for labeled indications. Pharmaceutical companies cannot disclose confidential data, nor can they discuss other proprietary information. In addition, the pharmaceutical industry is required by law to compile and report adverse drug reaction information. If a company receives an inquiry regarding a possible adverse effect associated with one of its products, the company is obligated to obtain detailed information about the event and report it to the federal government.

Searchers should consider when the information needed to answer the question might have appeared in the literature and then focus the search on the most likely interval of time. Inexperienced searchers often make the mistake of limiting the search to the default interval selected by the database. The search will be unsuccessful if the answer is in the older literature. For example, much of the definitive data regarding the pharmacokinetics of a drug and the pivotal trials regarding indications for which the drug is approved by the Food and Drug Administration (FDA) are published shortly before or shortly after a drug is approved by the FDA; drug approval dates are available on the FDA website (http://www.fda.gov). Case reports regarding less common adverse drug reactions often appear in the first few years after a new drug is marketed. The search may also fail if the desired information is in current literature that is not yet listed in the bibliographic database being searched. It may take several weeks to months for the bibliographic database to be updated with the most recent literature.

Primary Literature

Primary literature, consisting of original data, research, and case reports, is published in journals, other periodicals, and collections of research presentations or other special proceedings (Box 9-2). Primary literature generally contains the most recent information available for any given topic. The amount of full-text primary literature posted directly on the Internet is growing rapidly. Many major medical journals provide subscribers access to full-text literature through the journal's website. Journals may provide additional content (e.g., podcasts, videos, additional articles) available through the journal's website. Pharmacy and medical libraries may provide registered users access to full-text literature through bundled databases available by subscription. Some journals provide free online access to full-text articles in older issues through the journal's website.

Although primary literature is published in many venues, the quality of the information varies greatly. No information can be accepted at face value without a complete assessment of how the information was derived. One initial judge of the quality of a journal is the impact or perceived prestige of the journal. Authors try to publish in journals that have the greatest impact on health care professionals. Therefore these journals receive a lot of submissions. The high number of submissions means

Box 9-2 Common Primary Drug Information Resources

MEDICAL JOURNALS

General Medical Journals

American Journal of Medicine
Annals of Internal Medicine
Archives of Internal Medicine
British Medical Journal
Journal of the American Medical Association
Lancet
New England Journal of Medicine

Specialty Medical Journals

American Journal of Cardiology
American Journal of Respiratory and Critical Care Medicine
Annual Review of Immunology
Blood
Circulation
Critical Care Medicine
Diabetes
Gastroenterology
Hypertension
Journal of Allergy and Clinical Immunology
Journal of Infectious Disease
Journal of Clinical Oncology
Morbidity and Mortality Weekly Report
Pediatrics

PHARMACY AND PHARMACOLOGY JOURNALS

American Journal of Health-System Pharmacy
Annals of Pharmacotherapy
Clinical Pharmacology and Therapeutics
Consultant Pharmacist
Hospital Pharmacy
Journal of Clinical Pharmacology
Journal of the American Pharmacists Association
Pharmacotherapy
Pharmacy Today

that editors can select the highest-quality research with the most important results. Other general indications of quality include what the overall reputation of the journal is and whether the journal uses a peer-review process when selecting articles to be published. Information regarding whether a given journal uses peer review may be found on the journal's website.

Refereed articles have undergone peer review before acceptance for publication. The editors, after an initial internal review of the manuscript, ask outside experts for a thorough review of the manuscript. Peer review provides expert opinion regarding the originality of the material, validity of the data, appropriateness of the conclusions, and importance and relevance of the information.

The reputation of a journal also can be judged based on the citation rates for the articles it contains. According to a 1986 report on the impact of medical journals, the *New England Journal of Medicine* and *Lancet* accounted for more than one third of all 1981 citations.[2] Other frequently cited journals included the *Annals of Internal Medicine,* the *British Medical Journal,* and the *Journal of the American Medical Association.* These are general medical journals; specialty and subspecialty journals have smaller circulations and therefore are cited fewer times. The ten most-cited journals indexed by Thomson-Reuters between January 1, 1999, and April 30, 2009, were *Journal of Biological Chemistry, Proceedings of the National Academy of Sciences of the United States of America, Nature, Science, Physical Review Letters, Journal of the American Chemical Society, Physical Review B, Astrophysical Journal, New England Journal of Medicine,* and *Applied Physics Letters*.[3]

The journal impact factor (JIF), a measure developed by Dr. Eugene Garfield, is another means of assessing the influence of a journal. A journal's impact factor is calculated as the number of citations of the journal in a given period of time divided by the total number of citable items in the journal in that same period of time; the higher the JIF, the greater the journal's prestige.[4] JIFs for more than 5000 journals are published in *Journal Citation Reports* (JCR). In 2004, the *Annual Review of Immunology* was the top-ranked biomedical journal, with a JIF of 52.4.[4] Other top-ranked biomedical journals included *New England Journal of Medicine* (JIF of 38.6), *Journal of the American Medical Association* (JIF of 24.8), *Lancet* (JIF of 21.7), and *Annals of Internal Medicine* (JIF of 13.1).[4]

Secondary and Tertiary Literature

Secondary and tertiary literature consists of compiled information, including information from multiple databases, review articles published in journals, symposia proceedings published in journal supplements, and textbooks (Box 9-3). Secondary and tertiary literature includes reviews, analyses, interpretations, opinions, assessments, and conclusions drawn from multiple sources of information, including personal experience. Authorship of secondary and tertiary literature does not necessarily guarantee clinical expertise, because selection of authors may be more politically motivated than founded on knowledge of content.

The distinction between secondary and tertiary literature is imprecise. Although compiled periodicals and abstracting services are commonly referred to as *secondary literature* and textbooks and compendia are commonly referred to as *tertiary literature,* overlap occurs. Secondary literature tends to be slightly more current than tertiary literature but may not be subject to as extensive a prepublication review as tertiary literature.

Secondary and tertiary literature can be a good source of general or overview information about a topic but cannot be relied on to provide the most up-to-date information regarding indications, usage, mechanisms of action, adverse effects, and drug interactions. Secondary and tertiary literature may not contain any information about investigational drugs, newly marketed drugs, uncommon side effects and drug interactions, or new indications for previously marketed drugs.

Textbooks and other published books are the least up-to-date sources of information because publication takes 1 to 2 years, and the information contained in a book is out of date by at least that length of time the moment the book is published. In addition, the author or authors may have taken a year or more to write the text. A several-year gap may exist between new editions of textbooks, which makes the information even more out of date. Publishers are beginning to address these issues in several ways. Some publishers provide textbook websites where frequent updates are posted as new information becomes available. Some textbooks are published in print and electronic versions, and the electronic version is periodically updated and distributed. A growing trend is to publish textbooks only in the more easily updated electronic version.

Solid Oral Dosage Form Identification

Pharmacists frequently are asked to identify solid dosage forms. Several specialized secondary and tertiary print and subscription online searchable databases are available that provide this information. Some multi-use print books contain color photographs of commonly prescribed drugs (e.g., the *Physicians' Desk Reference* and the *Red Book*). More comprehensive resources include print books such as *Ident-A-Drug* and online databases such as *Lexi-Drug ID, Drug Identifier, Identidex,* and *Ident-A-Drug* that are typically searchable by drug imprint, National Drug Code (NDC) number, and drug name. The print books may not include recently marketed prescription or nonprescription drugs, and the online databases differ in scope. For example, a recent evaluation of online references for identifying nonprescription solid oral dosage forms found that the highest percentage of nonprescription drugs was identified using Identidex, followed by Ident-A-Drug.[5] An earlier evaluation found that Ident-A-Drug and Identidex identified the most prescription solid oral dosage forms.[6]

ACCESSING INFORMATION

Printed sources of information are accessed by searching the indexes of textbooks, locating articles in individually maintained files of journal article reprints, and searching

Box 9-3 Common Secondary and Tertiary Drug Information Resources

DRUG DATABASES FOR PERSONAL DIGITAL ASSISTANTS

Clinical Pharmacology OnHand (Gold Standard/Elsevier)
Epocrates Rx Pro (Epocrates, Inc.)
Lexi-Drugs (Lexi-Comp, Inc.)

ELECTRONIC DATABASES

Lexi-Comp (Lexi-Comp, Inc.)
Micromedex (Thomson Reuters)
UpToDate (UpToDate, Inc./Wolters Kluwer Health)

NEWSLETTERS AND BULLETINS

Clin-Alert (Sage Publications)
Facts and Comparisons Drug News Weekly (Facts and Comparisons/Wolters Kluwer Health)
The Medical Letter (The Medical Letter, Inc.)

SYSTEMS

DRUGDEX System (Thomson Reuters)
IDENTIDEX System (Thomson Reuters)
International Pharmaceutical Abstracts (Thomson Reuters)
Iowa Drug Information System (University of Iowa)
POISINDEX System (Thomson Reuters)

TEXTBOOKS

General

American drug index, ed 55, St Louis, 2011, Facts and Comparisons/Wolters Kluwer Health.
McEvoy GK, Snow EK, Miller J, et al: *AHFS drug information,* Bethesda, Md, 2011, American Society of Health-System Pharmacists.
Drug facts and comparisons, St Louis, 2011, Facts and Comparisons/Wolters Kluwer Health.
Anderson PO, Knoben JE, Troutman W, editors: *Handbook of clinical drug data,* ed 10, Stamford, Conn, 2001, McGraw-Hill Medical.
Sweetman SC, editor: *Martindale: the extra pharmacopoeia,* ed 36, Chicago, 2009, Pharmaceutical Press.
O'Neill MJ, editor: *The Merck index: an encyclopedia of chemicals, drugs, and biologicals,* ed 14, Whitehouse Station, NJ, 2006, Merck.
Physicians' desk reference, ed 65, Montvale, NJ, 2011, Medical Economics.
Gerbino PP, editor: *Remington: the science and practice of pharmacy,* ed 21, Philadelphia, 2005, Lippincott Williams & Wilkins.
United States pharmacopoeia—national formulary, USP33/NF28, Rockville, Md, 2010, Board of Trustees (United States Pharmacopeial Convention).

Drug Interactions

Hansten PD, Horn JR: *Hansten and Horn's drug interactions analysis and management,* ed 4, Philadelphia, 2009, Lippincott Williams & Wilkins.
Tatro DS, editor: *Tatro's drug interactions facts: the authority on drug interactions,* Philadelphia, 2009, Lippincott Williams & Wilkins.

Pharmacotherapeutics

Koda-Kimble MA, Young LY, Kradjan WA, et al, editors: *Applied therapeutics: the clinical use of drugs,* ed 9, Philadelphia, 2008, Lippincott Williams & Wilkins.
Berardi RR, Ferreri SP, Hume AL, et al, editors: *Handbook of nonprescription drugs,* ed 16, Washington, DC, 2009, American Pharmacists Association.
Fauci AS, Braunwald E, Kasper DL, et al, editors: *Harrison's principles of internal medicine,* ed 17, New York, 2008, McGraw-Hill.
DiPiro JT, Talbert RL, Yee GC, et al, editors: *Pharmacotherapy,* ed 7, New York, 2008, McGraw-Hill.
Helms RA, Quan DJ, Herfindal ET, et al, editors: *Textbook of therapeutics: drug and disease management,* ed 8, Philadelphia, 2006, Lippincott Williams & Wilkins.

Pharmacokinetics

Burton ME, Shaw LM, Schentag JJ, et al, editors: *Applied pharmacokinetics and pharmacodynamics: principles of therapeutic drug monitoring,* ed 4, Philadelphia, 2005, Lippincott Williams & Wilkins.

Specialty

Handbook of antimicrobial therapy, ed 18, New Rochelle, NY, 2008, Medical Letter.
Trissel LA: *Handbook on injectable drugs,* ed 15, Bethesda, Md, 2008, American Society of Health-System Pharmacists.
True B-L, Dreisbach RH, editors: *Dreisbach's handbook of poisoning: prevention, diagnosis, and treatment,* ed 13, London, 2002, Parthenon Publishing Group.
Briggs GG, Freeman RK, Jaffe SJ: *Drugs in pregnancy and lactation,* ed 8, Philadelphia, 2008, Lippincott Williams & Wilkins.
Custer JW, Rau RE, McMillan JA, et al: *Harriet Lane handbook,* ed 18, St Louis, 2008, Mosby.
Aronson JK, editor: *Meyler's side effects of drugs,* ed 15, New York, 2006, Elsevier Science.
Gilbert DW, Moellering RC, Eliopoulos GM, et al: *Sanford guide to antimicrobial therapy,* ed 39, 2009, Antimicrobial Therapy.

online bibliographic services. Some biomedical textbooks are published electronically, accessible online or on CDs that may be loaded onto personal desktop computers. Pharmacy libraries, medical libraries, and institutional (e.g., hospital) libraries may have extensive or very limited print resources. Online resources are available in most biomedical libraries. The increasing availability of wireless Internet networks allows clinicians to access institutional library resources as well as the Internet from many patient care areas (e.g., hospital wards, clinics, private offices).

Textbooks

Most people are familiar with how to locate information in printed textbooks using textbook indexes. The key to locating information through textbook indexes is to look for the precise topic and think of synonyms

and related terms if the initial search term is not listed. Electronic textbooks are usually searchable by keyword searches; chapter outlines and text links allow easy movement through the material. It may be necessary to search with several specific keywords before locating the desired information.

Individual Files

Most clinicians keep file copies of frequently used journal articles and other publications. Some filing systems are very straightforward; some are very complex. Some pharmacists set up their files using the AHFS numbering system. To locate specific topics, the searcher must be familiar with the AHFS or look up the drug topic in the AHFS book. For example, a research journal article about the efficacy of oseltamivir for the management of the novel H1N1 influenza infection would be filed in the 8:18 section (the first "8" identifies the antiinfective agent section and the "18" identifies the antivirals subsection). Other pharmacists use simpler but highly individualized topic groupings based on specific disease states, organ systems, or pharmacotherapeutic categories. Many pharmacists prefer to keep electronic file copies and have developed filing strategies based on drug or disease for managing the electronic files.

Computerized Bibliographic Databases

The availability of computerized bibliographic databases has simplified the process of obtaining drug information and greatly expanded access to published information. Examples of health-related bibliographic databases are MEDLINE, Current Contents, International Pharmaceutical Abstracts (IPA), and CancerLit. Access to computerized databases is through public and commercial vendors. The NLM, the creator of MEDLINE, is an example of a public vendor. Dialog Information Services and Bibliographic Retrieval Services (BRS) are examples of commercial vendors. Computerized bibliographic databases can be searched by librarians as a service for health care professionals or by the end user. End-user online searching is rapidly becoming the standard of practice, because wireless systems and smart-phone networks provide access to these databases in a variety of patient care areas, drug information centers, medical and pharmacy libraries, offices, and homes. Many online bibliographic databases were started in the mid-1960s and early 1970s; information dating earlier than that usually must be located on site using manual indexes, pulled from the library shelves, and photocopied manually.

Three types of information may be available to searchers of computerized bibliographic databases. First, most bibliographic databases provide at least the full bibliographic citation, including all authors, title, journal, year, volume number, issue number, and inclusive page numbers. Key indexing terms are listed, which may allow the user to narrow the search, trigger ideas about additional search terms, and suggest related topics. Second, the manuscript abstract may be provided. Third, some of the databases provide the full text of selected articles. Access to full-text articles may be limited to current journal subscribers or to users of specific bundled databases to which a given institution has subscribed. Some journals provide access to their holdings by charging nonsubscribers a fee for downloading each full-text article.

Internet Resources

Searchable bibliographic databases are limited to previously published information (e.g., studies, reviews, editorials, letters to the editor). This limit confers a certain degree of reliability but restricts access to other information. Although the availability of full-text publications is increasing, it remains confined to major medical journals. In addition, some delay (weeks to months) always occurs between publication in the print media and inclusion of the information in the bibliographic databases. In contrast, information published directly on the Internet is completely unrestricted and often posted very quickly.

The Internet provides access to a wide array of information. One clear advantage of the Internet is the connection of information through cross-listings and links that provide rapid access to related information. The primary advantage of the Internet (access to a vast array of unlimited and uncontrolled information) also is its greatest disadvantage, however. No person or group controls the Internet, no universal indexing system is available, and no quality controls are in place. No assurances are made as to the timeliness, validity, and/or reliability of information.

Information on the Internet is searched for and retrieved using search engines (e.g., Google, Netscape Search, Yahoo, Bing, WebCrawler), software programs that index and search Internet resources. Search engines locate information by searching for specified terms and phrases; links between terms can be made using Boolean logic (e.g., *and, or, not*). Search results are displayed in lists ranked according to the degree to which the terms and topics match. Because search engines differ in the scope of Internet sources searched, searches performed using more than one search engine may disclose different information.

Locating incomplete, inaccurate, or false information on the Internet is a risk; sites should be evaluated carefully before citing the information (Box 9-4). Site quality is difficult to assess.[7] Several organizations (e.g., Health Information Technology Institute of Mitretek Systems,[8] Health on the Net Foundation [HON],[9] National Center for Complementary and Alternative Medicine[10]) have a proposed guide for assessing websites that offer health-related information. HON is an example of a self-regulatory, voluntary certification system for health care websites.[9] Sites that meet HON criteria are identified by a blue and red HONcode seal, usually displayed on a site's home page. Websites belonging to government agencies (e.g., http://www.fda.gov, http://www.nih.gov, http://www.nlm.nih.gov), pharmaceutical companies (e.g., GlaxoSmithKline, http://www.gsk.com; AstraZeneca, http://www.astrazeneca-us.com), professional organizations (e.g., American Pharmacists Association, http://www.pharmacist.com; American Society of Health-System Pharmacists, http://www.ashp.org), and academic institutions (e.g., Arizona Poison and Drug Information Center, http://www.pharmacy.arizona.edu) are generally reliable drug information sources.

Box 9-4 Questions to Ask When Evaluating Websites that Provide Health-Related Information

WEBSITE-RELATED QUESTIONS
Who runs the website?
Who pays for the website?
What is the purpose of the website?
Are links current?
Are links appropriate?
Is the website searchable?
Is the date of the last website update posted?
What information does the website collect from users?

AUTHORSHIP-RELATED QUESTIONS
Who controls content?
Are authors identified?
What are the authors' credentials?
Are author credentials related to the information provided?
Is there a way to contact the authors directly?

INFORMATION-RELATED QUESTIONS
Are opinions separate from facts?
Are facts referenced?
Is the information current?
Is the information relevant?
Is the information balanced?
Is the information peer reviewed?
Are author-related or site-related financial conflicts of interest identified?

From: Ling CA: Guiding patients through the maze of drug information on the Internet. *Am J Health Syst Pharm* 56:212-214, 1999. Assessing the Quality of Internet Health Information. Summary. Rockville, Md, Agency for Health Care Policy and Research; McLean, Va, Mitretek Systems. Available at: http://www.ahrq.gov/data/infoqual.htm. Accessed December 14, 2009. Health on the Net Foundation: Code of Conduct (HONcode) for Medical and Health Websites. Available at: http://www.hon.ch/HONcode/conduct. Accessed December 14, 2009. National Center for Complementary and Alternative Medicine: Evaluating Web-Based Health Resources. Available at: http://www.nccam.nih.gov/health/webresources. Accessed December 14, 2009.

Personal Digital Assistant Software

Drug information database software developed for loading on personal digital assistants (PDAs) or accessing on the Internet via smart-phone cell phone technology is available by subscription. The easy access to these databases has made them very popular with health care professionals. Most clinicians appreciate the convenience of immediate access to drug information in all patient care environments, from bedside to clinic.

Many different commercial PDA drug information software programs are available. A 2007 study assessed five drug information databases that are available in a version for PDAs as well as online via the Internet. The study evaluated the programs in terms of scope, completeness, and ease of use.[11] The ranking of the PDA databases (from highest to lowest) based on overall composite score was as follows: Lexi-Drugs, Clinical Pharmacology OnHand, Epocrates Rx Pro, Thomson Clinical Xpert (called *mobile*Micromedex at the time of the study), and Epocrates Rx free version. Four of the online databases had significantly greater scope than the PDA versions (Clinical Pharmacology online, Micromedex, Lexi-Comp Online, and Epocrates Online Premium). The online Micromedex database was more complete in scope than the PDA version, but the other databases did not differ in terms of completeness. The demand for PDA drug information databases may decline as online drug information databases become more widely available through rapidly expanding wireless computer access.

CRITICALLY APPRAISING INFORMATION

Information from any source must be appraised critically. Evaluate all information, including textbooks, review articles published in refereed and nonrefereed journals, and original research articles, for timeliness, reliability, and applicability before using the information to answer a question.

Textbooks

Information obtained from textbooks is evaluated from several different perspectives. Note the publication date. Older texts (texts published more than 4 or 5 years ago) may contain information that was correct at the time of publication but is inaccurate based on currently available information. This is especially true for information related to pharmacotherapeutics, pathophysiology, pharmacology, and other rapidly developing medical fields. Textbooks also may contain errors; do not accept any information at face value but verify it in a second, more recent source.

Note the author of the chapter or book and determine whether the author has the expertise and experience necessary to be an authoritative source of information. Ideally, authors should be practitioners who deal regularly with the issues they are writing about and should be familiar with the literature and state-of-the-art issues relevant to the topic.

Literature Reviews

Literature reviews, also known as *review articles,* are published in refereed and nonrefereed journals, special supplements to journals, and other formats. Literature reviews provide information somewhat intermediate between original research and textbooks. Literature reviews must be evaluated carefully (Box 9-5).[12-14] As with textbooks, determine the timeliness of the articles by checking the date of publication and assess author expertise.

Assess how the authors selected and evaluated the primary research used as the basis of the review. The purpose of the review should be clearly spelled out in the introduction. Because the conclusions of the review article are based on information obtained from relevant original research, the methodology used to locate the research publications should be identified and outlined. Data obtained from previous review articles should not be used; the authors should locate and assess relevant original data, not another author's interpretation of the data. The criteria for extraction and acceptance of data from the original research should be specific and documented.

Determine whether the author's conclusions are supported by the data.

Original Research

Published research, primarily in the form of reports of clinical trials, is an important source of drug information. Research reports often are cited as proving the usefulness of specific therapeutic agents for new or unapproved indications and as the basis for proving or disproving the association between a drug and a specific adverse drug reaction or interaction. However, original research articles must be evaluated carefully (Box 9-6). The results as stated by the authors cannot be accepted at face value. A thorough and critical appraisal of the research methodology must be completed before the information can be accepted and used to make patient care decisions. Results of a single study cannot stand alone in changing clinical practice. Multiple studies of different patient populations are needed to support a change in clinical practice.[15]

Assess the validity and applicability of the research.[15-17] *Validity* refers to the likelihood that the study results are true. *Applicability* refers to the likelihood that the study results can be useful for clinical decision making. Consider subject characteristics (e.g., age, sex, severity and duration of disease) and decide whether they are similar to those of the patient in question. All studies are flawed; however, study results can be applied to specific patient situations if considered in terms of the strengths and weaknesses of the study.

Critical appraisal of original research begins with a review of the abstract. Abstracts usually contain enough information to determine whether the study applies to the question at hand and is strong enough to merit further evaluation. Structured abstracts in which the objective,

Box 9-5 Questions to Ask When Evaluating Review Articles

1. What are the qualifications of the author(s)?
2. Was the question clearly stated?
3. Were relevant studies located using a comprehensive search strategy?
4. Were the selection criteria used to choose studies explicit and clearly identified?
5. Was each study valid?
6. Were study results combined appropriately?
7. Were the conclusions supported by the combined data?

Box 9-6 Questions to Ask When Evaluating Original Research

1. Title
   - Does the title accurately reflect the study?
2. Investigators
   - What are the author affiliations? Are there any declared or undeclared conflicts of interest?
   - Do the authors have other publications in this area?
   - Have the authors published other articles related to this study?
3. Study funding
   - Who funded the study?
   - Are there any declared or undeclared conflicts of interest?
4. Human research review board approval
   - Was the study approved by a human research review board?
5. Introduction and background
   - Do the introduction and background provide enough information to justify doing the study?
6. Study design
   - What is the study design?
     - Randomized or nonrandomized
     - Controlled or open label
     - Unblinded, single-blinded, or double-blinded
     - Single center or multicenter
     - Prospective or retrospective
     - Placebo controlled or active comparison
     - Single arm or multiple arms
     - Crossover or parallel
     - Phase I, II, III, or IV
   - Is the study design appropriate for the study objectives?
     - What are the study objectives?
     - What are the primary and secondary end points? Are the end points appropriate for the study objectives?
     - What are the inclusion criteria? Are the inclusion criteria appropriate for the study objectives?
     - What are the exclusion criteria? Are the exclusion criteria appropriate for the study objectives?
7. Data analysis
   - Was the study appropriately powered?
   - Were the laboratory analytical methods appropriate?
   - Were the planned statistical analyses appropriate?
   - Was an intention-to-treat analysis performed?
   - Are any types of error (type I or type II) present?
   - Are all subjects accounted for?
   - How were missing data handled?
   - Are statistically significant results clinically relevant?
8. Results and discussion
   - Are results for all study objectives provided?
   - Are the results supported by the data?
   - Are the tables and graphs accurate representations of the study data and results?
   - Are the study strengths and weaknesses appropriately identified and described?
   - Does the discussion place the results in context with previously published information?
9. Conclusion
   - Is the conclusion supported by the facts?
10. Other
    - Was the study outcome influenced by uncontrolled factors (e.g., seasonal variations in disease severity, disease progression)?
    - Are the results generalizable or limited to a specific patient population?

KT thanks Gary E. Slosky, PharmD, associate professor of clinical pharmacy, Philadelphia College of Pharmacy, University of the Sciences in Philadelphia, for developing the study design checklist on which this list is based.

study design, setting, subjects, interventions, main outcome measures, results, and conclusions are clearly identified and summarized allow the reader to determine quickly the potential applicability and usefulness of the study.[18]

Look for the study objective. The objective, a statement of the specific scientific questions, is usually given in the introductory section of the paper. One of the key components of critical appraisal of original research is to determine whether the authors conducted a study appropriately designed to accomplish the stated objective.

Note the basic study design and determine whether the study design is appropriate for the study objective. For example, interventional studies, commonly used to compare drug regimens, are typically randomized or nonrandomized controlled trials. These types of studies can be blinded or nonblinded, placebo or active drug controlled, and crossover or parallel in design. It would be difficult to conclude that a new drug is the drug of choice if the study compared the new drug with a placebo rather than with the currently accepted drug of choice. Note whether patient adherence to study requirements (e.g., medication, diet, exercise) was assessed and also review the methods used to assess adherence (e.g., pill counts, random blood or urine screens, witnessed drug administration).

Note the study setting and determine whether the setting is appropriate for the study objective. For example, although multicenter trials are difficult to conduct and introduce more chances for study-related errors, multicenter trials are an appropriate study design for rare or unusual disease states or drug treatments.

Note the study participant characteristics and determine whether these characteristics are appropriate for the study objective. Note how study participants were selected (e.g., serial admissions, a random sample from a clinic population, by special invitation), whether the study used healthy volunteers or patients, and the patient care setting (e.g., outpatient or inpatient). Consider the median age and range of ages of subjects included in the study, the gender distribution of the subjects, and the socioeconomic features of the study population. Explanations of the number of subjects who withdrew and their reasons should be noted; all subjects enrolled in a study should be accounted for in the results.

Assess the primary and secondary study outcomes. Study objectives are the specific research questions addressed in the study. Primary study objectives are the key questions; secondary study objectives are supplementary or exploratory questions. Primary and secondary study outcome parameters are the measurements or observations used to investigate the study objectives. Note whether the outcome parameters are appropriate for the study objectives and whether the parameters used to measure the outcomes are appropriate, comprehensive, and clinically applicable to the study objectives. Note whether all planned study outcomes are reported on. Practices such as selective outcome reporting, introduction of new primary outcomes, switching of primary outcomes to secondary outcomes, and switching of secondary outcomes to primary outcomes threaten the validity of all reported study results. For example, a recent analysis of 12 published original clinical trials of the use of gabapentin for off-label indications (migraine prophylaxis and treatment of nociceptive pain, neuropathic pain, and bipolar disorders) found evidence of selective outcome reporting, which called into question the validity of all gabapentin off-label trials.[19]

Review the study results in detail. Look at the data contained in the tables, graphs, and charts in detail to verify the author conclusions and note whether the published conclusions are supported by the data and whether the statistical analyses are appropriate for the study design and types of data. Determine whether the study results, even if statistically significant, are clinically important.

ANSWERING THE QUESTION

Once information is located and analyzed, formulate the answer and convey the answer to the person asking the question. Finding an answer may be as simple as looking up a specific drug dosage or may require an extensive search for information and the assessment and synthesis of numerous original research articles. In either case the answer must be timely, concise, precise, and appropriate to the background of the person asking the question. The answer should be fully referenced.

Verbal communication of drug information must be clear and fluent. The information should be well organized, with an appropriate emphasis on important details. Convey the answer with confidence and at a level appropriate to the person asking the question. For example, when providing drug information to a lay person, make sure that the information is expressed in terms understandable by a person with no medically related expertise. Be prepared to expand on the information according to the needs of the person asking the questions. Anticipate follow-up questions and be prepared to address them.

Written communication of drug information must be well organized, complete, and well written. Use correct sentence and paragraph structure and correct grammar, punctuation, and spelling. Document references in a uniformly accepted format such as that described in "Uniform Requirements for Manuscripts Submitted to Biomedical Journals."[20]

The written response includes a statement of the question, relevant patient details (e.g., age, disease history, drug history), relevant data from the literature sources, evaluation of the literature cited, summary, conclusions and recommendations, and references. The written response should flow well, with smooth transitions between sections. Document the name of the person asking the question and the name of the person answering the question.

File the question, answer, and answer sources for future reference. In some situations (e.g., in drug information centers), a written response to a question is documented in a specific format. In some cases the question and response are written directly in or added to the patient's chart.

DRUG INFORMATION CENTERS

The University of Kentucky Drug Information Center was the first drug information center in the United States. It began operation in 1962. The Center was created to

provide drug information, assess adverse drug reaction information, support student and drug information specialist education and training and stimulate the develop of additional drug information centers.[21] These tasks remain the focus of most drug information centers today. The primary activities of drug information centers include drug information activities; formulary activities; publication of newsletters and other related materials; staff development; investigational drug program activities; drug use review; adverse drug reaction reporting; research; and training of students, pharmacy residents, and drug information specialists.

Drug information specialists are pharmacists who have completed specialized training in drug information, generally in the form of 1-year residency programs in drug information provided by hospitals and other drug information centers. Drug information specialists are skilled in locating and evaluating drug information and in communicating with pharmacists, physicians, other health care providers, and patients.

In 2003 there were 89 pharmacist-operated drug information centers.[22] By 2009, only 75 of these drug information centers were still active.[22] Most of these centers are located in hospitals and run by the hospital's pharmacy department. However, some drug information centers are located in medical libraries, colleges of pharmacy, and poison control centers. There are two federally funded drug information centers: the drug information center in the Center for Biologics Evaluation and Research (CBER) and the drug information center in the Center for Drug Evaluation and Research (CDER).[23] These federal drug information centers provide regulatory guidance as well as drug information. Most pharmaceutical companies maintain in-house drug information centers.[24] The decline in the number of drug information centers may reflect the increasing availability of drug information for consumers and health care professionals through the Internet and other electronic resources. Although the number of pharmacist-operated drug information centers is decreasing, drug information centers are more involved in health care student education and are handling increasingly complex questions that require more time to answer.[22]

SAMPLE DRUG INFORMATION QUESTIONS

INTRAVENOUS ADMIXTURE DRUG COMPATIBILITY

Question: A patient is receiving a continuous infusion of sodium bicarbonate. Amikacin is prescribed. Is amikacin compatible with sodium bicarbonate?
Answer: Yes, when administered using a Y site.
Source: Trissel LA: *Handbook on injectable drugs,* ed 15, Bethesda, Md, 2008, American Society of Health-System Pharmacists.
Comments: Intravenous drug compatibility questions are very common questions for pharmacists who work in hospitals. Most hospital pharmacists know the intravenous admixture drug compatibility data for the drugs most commonly used in their institutions but may need to consult a definitive reference source for less commonly used drugs. Some drug package inserts contain drug compatibility information.

SOLID ORAL DOSAGE FORM IDENTIFICATION

Question: A patient is taking a round white tablet with the imprint "MSD 456." What is this medication?
Answer: Aldoril (methyldopa 250 mg and hydrochlorothiazide 25 mg)
Source: Lexi-Comp Online
Comments: Identification of solid oral dosage forms with imprints is relatively straightforward; most drug identification texts and online systems should easily identify these types of products. It is very challenging to identify a solid oral dosage form with no distinguishing characteristics. Some of the more comprehensive drug identification systems will lead the searcher through a more complex identification process based on size, color, shape, thickness, and other dosage form characteristics.

DOSE

Question: What is the dose of tiotropium bromide (Spiriva) for a patient with chronic obstructive pulmonary disease?
Answer: 18 mcg (one capsule) inhaled via the HandiHaler drug delivery device
Source: Spiriva prescribing information found on the Spiriva website (http://www.spiriva.com)
Comments: Spiriva is a commonly prescribed medication for a very prevalent disease with its own website that contains consumer and health care professional drug and disease information. The dose information may also be found in the printed package insert, PDA and online databases, and therapeutics-related textbooks.

FDA-APPROVED INDICATIONS

Question: What are the FDA-approved indications for cefepime?
Answer: Cefepime is indicated for the treatment of select infections caused by susceptible strains of microorganisms: moderate to severe pneumonia caused by *Streptococcus pneumoniae, Pseudomonas aeruginosa, Klebsiella pneumoniae,* or *Enterobacter* species; uncomplicated and complicated urinary tract infections caused by *Escherichia coli* or *K. pneumoniae* (mild, moderate, or severe infections) or *Proteus mirabilis* (when the infection is mild to moderate); uncomplicated skin and skin structure infections caused by *Streptococcus pyogenes* or methicillin-susceptible strains of *Staphylococcus aureus;* and complicated intraabdominal infections (in combination with metronidazole) caused by *E. coli,* viridans group streptococci, *P. aeruginosa, K. pneumoniae, Enterobacter* species, or *Bacteroides fragilis*. It is also indicated as empiric monotherapy for patients with febrile neutropenia.
Source: Online Facts and Comparisons
Comments: The FDA-approved indications for drugs may be found in the package insert, drug information databases, and therapeutics textbooks (print and online).

VACCINATION INDICATIONS

Question: A 60-year-old African American woman who lives in her own home and has no known medical problems asks if she can get the pneumococcal vaccine today.
Answer: No. The pneumococcal vaccine is indicated only for adults 65 years of age and older, for patients with specific medical conditions that place them at high risk of complications, and for Alaska Natives, certain American Indians, and residents of nursing homes or long-term care facilities.
Source: Centers for Disease Control and Prevention immunization schedule (http://www.cdc.gov/vaccines/recs/schedules)
Comments: The FDA-approved indications for drugs, including vaccines, may be found in the package insert, drug information databases, and therapeutics textbooks (print and online).

DOSING IN SPECIAL SITUATIONS

Question: What is the adult dosage of intravenous acyclovir for the treatment of herpes simplex virus (HSV) encephalitis? The patient is 5′6″ tall and weighs 250 lb.
Answer: 588 mg intravenously every 8 hours for 10 days
Source: Acyclovir package insert
Comments: The recommended dosage, 10 mg/kg per dose intravenously every 8 hours for 10 days, may be found in multiple drug information databases. But many databases do not provide guidance on whether the drug should be dosed based on actual or ideal body weight. The drug labeling (package insert) recommends using ideal body weight.

ADVERSE DRUG REACTIONS

Question: What is the risk of telithromycin (Ketek)–associated liver failure?
Answer: Brinker et al, in an assessment of the spontaneous adverse event reports regarding telithromycin-associated liver injury received by the FDA, concluded that telithromycin is a rare cause of drug-induced liver injury.
Source: Brinker AD, Wassel RT, Lyndly J, et al: Telithromycin-associated hepatotoxicity: clinical spectrum and causality assessment of 42 cases. *Hepatology* 49:250-257, 2009.
Comments: This is the type of question that requires search of the primary literature. Given the relatively recent recognition of the issue, the search was initiated using the most current MEDLINE database; the relevant report was located immediately. One might think that the drug labeling (package insert) would contain this type of information, but usually it does not. The telithromycin drug labeling (package insert) contains a warning about possible acute hepatic failure and severe liver injury but does not provide any numerical data.

TOXICOLOGY

Question: What electrocardiogram changes are associated with amitriptyline toxicity?
Answer: QRS prolongation greater than 100 msec, deep S waves in leads I and augmented voltage left arm (aVL), and R waves in lead augmented voltage right arm (aVR).
Source: Lexi-Tox
Comments: This information is widely available and may be found in print and online drug toxicology references and other drug information databases.

CONSENSUS GUIDELINES

Question: What medication is recommended for the initial management of fibromyalgia syndrome?
Answer: Low-dose tricyclic antidepressant or cyclobenzaprine
Source: The current "Management of Fibromyalgia Syndrome" guideline published by the American Pain Society Fibromyalgia Panel (available from the National Guideline Clearinghouse at http://www.guidelines.gov).
Comments: The National Guideline Clearinghouse contains a searchable database of evidence-based guidelines and is an excellent source of information on these types of evidence-based, consensus-driven recommendations. There may be a delay in posting updated guidelines. Check the guideline source (e.g., the society that published the guidelines) to verify that the guideline is the most current version.

DRUGS IN PREGNANCY

Question: Is loratadine safe to take during pregnancy?
Answer: Loratadine taken in the usual dosages is unlikely to pose a substantial risk, but the data are insufficient to state that there is no risk.
Source: Reprotox
Comments: Information regarding drug use during pregnancy is available in several print and online databases. The drug labeling (package insert) also contains a statement regarding use of the drug during pregnancy.

APPLICATION ACTIVITIES

These activities are best carried out in pairs or small groups of up to four individuals.

1. For each of the drug information questions on pages 163-164, look up the information in multiple resources and compare (a) the ease of finding the information and (b) the information itself (completeness, references, etc.).
2. Select a primary article from a peer-reviewed journal and evaluate the article using the checklist in Box 9-6. Discuss the strengths and weaknesses of the study and state how the information from the study is best used in clinical practice.
3. Select a review article from a peer-reviewed journal and evaluate the article using the checklist in Box 9-5. Discuss the strengths and weaknesses of the article and state how the information from the review is best used in clinical practice.

SELF-ASSESSMENT QUESTIONS

1. The provision of drug information involves which of the following components?
   a. Determining the primary question
   b. Developing an appropriate search strategy
   c. Assessing available information
   d. All of the above
   e. None of the above
2. A consumer asks whether her new prescription drug is the cause of her insomnia. What type of drug information question is this?
   a. Adverse reaction
   b. Dosing
   c. Drug administration
   d. Indication and therapeutic use
   e. Poisoning and toxicology
3. A colleague asks if ipratropium bromide (Atrovent) is FDA approved for the treatment of asthma. What type of drug information question is this?
   a. Adverse reaction
   b. Dosing
   c. Drug administration
   d. Indication and therapeutic use
   e. Poisoning and toxicology
4. Which one of the following is an example of primary literature?
   a. An original study published in the *New England Journal of Medicine*
   b. A review of a newly marketed drug published in the *Medical Letter*
   c. A drug interaction described in a drug interactions book
5. Which one of the following is an example of secondary literature?
   a. An original study published in the *New England Journal of Medicine*
   b. A review of a newly marketed drug published in the *Medical Letter*
   c. A drug interaction described in a drug interactions book
6. Which one of the following is an example of tertiary literature?
   a. An original study published in the *New England Journal of Medicine*
   b. A review of a newly marketed drug published in the *Medical Letter*
   c. A drug interaction described in a drug interactions book
7. Which of the following literature databases contains the largest number of journal citations?
   a. MEDLINE
   b. PubMed
8. When are journal articles regarding less common adverse drug reactions most likely to appear in the primary literature?
   a. The year the drug was approved by the FDA
   b. Five years before the drug was approved by the FDA
   c. The year after the drug was approved by the FDA
   d. In the first few years after the drug was approved by the FDA
9. Which of the following should be considered when evaluating an original research article?
   a. Appropriateness of the study design
   b. Clinical relevance of statistically significant results
   c. Study participant characteristics
   d. All of the above
   e. None of the above
10. Which of the following should be considered when evaluating a literature review?
    a. Publication date
    b. Author expertise
    c. Criteria the author used to select the primary research articles
    d. All of the above
    e. None of the above
11. Which of the following is the *most* appropriate source of information regarding questions of fact such as usual dosage regimens?
    a. The pharmaceutical company
    b. A colleague
    c. A standard pharmacy textbook
    d. An online search of the published literature
    e. All of the above
12. Which of the following is the *most* appropriate source of information regarding an unapproved indication for a currently marketed drug?
    a. The pharmaceutical company
    b. A colleague
    c. A standard pharmacy textbook
    d. An online search of the published literature
    e. All of the above

evolve WEBSITE

http://evolve.elsevier/Tietze

Audio glossary terms

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CHAPTER

10 Ethics in Pharmacy and Health Care

LEARNING OBJECTIVES

- Identify the fundamental moral principle on which all ethical behavior is based.
- Define each of the following terms: *autonomy, beneficence, nonmaleficence,* and *justice*.
- Describe the commonalities among the pharmacy, medical, and nursing codes of ethics.
- Describe the intent and content of the Patients' Bill of Rights.
- Describe the intent and content of the Patient Care Partnership.
- List actions pharmacists should take to uphold patient confidentiality.
- Identify the two internationally recognized research codes of ethics.
- State the composition and responsibilities of research review boards.
- Identify the required and optional elements of informed consent.
- Describe two ethical implications of accepting gifts from the pharmaceutical industry.
- Differentiate between the purposes of living wills and durable powers of attorney.
- State at least one advantage and one disadvantage of living wills and durable powers of attorney.

All ethical behavior is based on the fundamental moral principle of doing good and avoiding evil. Ethical behavior in the profession of pharmacy also means conforming to the rules governing the rights and duties of pharmacists, patients, and other health care professionals.

The four basic medical ethics principles are autonomy, beneficence, nonmaleficence, and justice.

- *Autonomy,* also known as *free will,* refers to the moral right of patients to make their own decisions. Autonomy, often referred to as *first among equals* because it contributes to the other three principles, is described as "the ability to think for oneself about the way one wishes to lead one's life based on that thinking, and then to enact those decisions."[1]
- *Beneficence* means to do good and avoid harm, and includes an obligation to help patients.
- *Nonmaleficence* means to do no harm. Because most medical interventions, including nonprescription and prescription medications, have the potential for serious harm, the principle of nonmaleficence typically is interpreted to mean ensuring that potential benefits outweigh the potential risks.
- *Justice,* sometimes referred to as *distributive justice,* is the principle that people in similar situations should be treated equitably.

Health care professionals grapple with many ethical issues (Box 10-1). Some issues, such as the use of animals in drug development, are of interest to health professionals in general but have minimal impact on the daily practice of pharmacy. Other issues, such as confidentiality and withholding or withdrawing specific therapeutic interventions, commonly influence the daily practice of pharmacy.

This chapter identifies and describes the professional codes of ethics that form the basis of professional ethical behavior and discusses several professional ethical issues, including confidentiality, research ethics, ethics and the promotion of drugs, the use of advance directives in end-of-life decisions, and several contemporary ethical issues, including promotion of prescription drugs and conscientious objection. Additional information regarding biomedical ethical principles is available in the biomedical ethics literature. Detailed specific discussions regarding biomedical ethical issues are published in the medical literature; discussions of specific dispensing-related ethical issues are published in the pharmacy literature.

PROFESSIONAL CODES OF ETHICS

The medical code of ethics, often considered the foundation for ethical behavior in health care, dates to the time of Hippocrates; other codes of ethics are more recent but were often derived from the Hippocratic Oath. Most health professions have specific codes of ethics that provide written guidelines regarding ethical behavior. Most professional codes of ethics are written using broad-based directives that do not provide issue-specific guidelines. This means that the ethical guidelines for most health care professionals are deliberately vague. Therefore, to be ethical health professionals are required to apply their professional codes of ethics within a framework of societal moral values. Individual philosophies and beliefs must be considered and respected.

Box 10-1 Examples of Health Care-Related Ethical Issues

Abortion
Assisted reproduction
Assisted suicide
Confidentiality
Conscientious objection
Donation of genetic material
Emergency contraception
Euthanasia
Oral contraception
Performance enhancement (e.g., steroids)
Pharmacy benefit management
Promotion of prescription drugs
Rationing of health care
Research
  Animal testing
  Biologic research
  Genetic research
  Informed consent
  Investigational drugs
Risk-benefit limitations (e.g., clozapine)
Substance abuse and dependence
Withholding or withdrawal of treatment interventions
  Cardiopulmonary resuscitation
  Fluids
  Intubation and ventilation
  Nutrition (tube feedings, total parenteral nutrition)
  Kidney dialysis

HIPPOCRATIC OATH

The Hippocratic Oath, attributed to the fifth century BC Greek physician Hippocrates, is considered the basis for modern medical ethical standards.[2] The oath is found in the Hippocratic corpus, a collection of literature containing case reports, descriptions of disease processes, and medical philosophies generally attributed to Hippocrates. Issues addressed in the oath include patient advocacy, patient confidentiality, professional misconduct, and the need to defer to those with more appropriate training and experience (Box 10-2).

There are several modernized versions of the Hippocratic Oath. The newer versions of the Hippocratic Oath differ from the original version in that they typically do not require swearing by any higher authority and make no reference to abortion, euthanasia, or sexual behavior.[3] Graham states that "the original oath is redolent of a covenant, a solemn and binding treaty. By contrast, many modern oaths have a bland, generalized air of 'best wishes' about them."[3] Dr. Louis Lasagna, the father of pharmacology, wrote a commonly cited modern version of the Hippocratic Oath in 1946 while serving as academic dean of the School of Medicine at Tufts University (Box 10-3).[4]

PHARMACY CODE OF ETHICS

The foundation of ethical pharmacy behavior is the premise that the welfare of humanity is the pharmacist's primary consideration. The declaration that "every pharmacist shall devote himself carefully and diligently to his task so that the sick and suffering are not neglected and no harm is done to them" was made by a group of pharmacists in 1456.[5] The document containing this statement is considered one of the oldest known ethical commitments made by a group of pharmacists.

The first American pharmacy code of ethics was adopted in 1848 by the Philadelphia College of Pharmacy.[6] This early pharmacy code of ethics states the responsibility of the pharmacist to the patient and recognizes the professional relationship between pharmacists and physicians. The preface to the code includes the following statement[6]:

Pharmacy being a profession which demands knowledge, skill, and integrity on the part of those engaged in it, and being associated with the medical profession in the responsible duties of preserving the public health, and dispensing the useful though often dangerous agents adapted to the cure of disease, its members should be united on some general principle to be observed

Box 10-2 The Classical Hippocratic Oath

I swear by Apollo Physician and Asclepius and Hygieia and Panaceia and all the gods and goddesses, making them my witnesses, that I will fulfill according to my ability and judgment this oath and this covenant:

To hold him who has taught me this art as equal to my parents and to live my life in partnership with him, and if he is in need of money to give him a share of mine, and to regard his offspring as equal to my brothers in male lineage and to teach them this art—if they desire to learn it—without fee and covenant; to give a share of precepts and oral instruction and all the other learning to my sons and to the sons of him who has instructed me and to pupils who have signed the covenant and have taken an oath according to medical law, but to no one else.

I will apply dietetic measures for the benefit of the sick according to my ability and judgment; I will keep them from harm and injustice.

I will neither give a deadly drug to anybody who asked for it, nor will I make a suggestion to this effect. Similarly I will not give to a woman an abortive remedy. In purity and holiness I will guard my life and my art.

I will not use the knife, not even on sufferers from stone, but will withdraw in favor of such men as are engaged in this work.

Whatever houses I may visit, I will come for the benefit of the sick, remaining free from all intentional injustice, of all mischief and in particular of sexual relations with both female and male persons, be they free or slaves.

What I may see or hear in the course of the treatment or even outside of the treatment in regard to the life of men, which on no account one must spread abroad, I will keep to myself holding such things shameful to be spoken about.

If I fulfill this oath and do not violate it, may it be granted to me to enjoy life and art, be honored with fame among all men for all time to come; if I transgress it and swear falsely, may the opposite of all this be my lot.

From Edelstein L: The Hippocratic Oath: text, translation and interpretation. In Temkin O, Temkin CL, editors: *Ancient medicine: selected papers of Ludwig Edelstien,* Baltimore, 1967, Johns Hopkins University Press, pp 3-64.

Box 10-3 The Modern Hippocratic Oath

I swear to fulfill, to the best of my ability and judgment, this covenant:

I will respect the hard-won scientific gains of those physicians in whose steps I walk, and gladly share such knowledge as is mine with those who are to follow.

I will apply, for the benefit of the sick, all measures [that] are required, avoiding those twin traps of overtreatment and therapeutic nihilism.

I will remember that there is art to medicine as well as science, and that warmth, sympathy, and understanding may outweigh the surgeon's knife or the chemist's drug.

I will not be ashamed to say "I know not," nor will I fail to call in my colleagues when the skills of another are needed for a patient's recovery.

I will respect the privacy of my patients, for their problems are not disclosed to me that the world may know. Most especially must I tread with care in matters of life and death. If it is given me to save a life, all thanks. But it may also be within my power to take a life; this awesome responsibility must be faced with great humbleness and awareness of my own frailty. Above all, I must not play at God.

I will remember that I do not treat a fever chart, a cancerous growth, but a sick human being, whose illness may affect the person's family and economic stability. My responsibility includes these related problems, if I am to care adequately for the sick.

I will prevent disease whenever I can, for prevention is preferable to cure.

I will remember that I remain a member of society, with special obligations to all my fellow human beings, those sound of mind and body as well as the infirm.

If I do not violate this oath, may I enjoy life and art, respected while I live and remembered with affection thereafter. May I always act so as to preserve the finest traditions of my calling and may I long experience the joy of healing those who seek my help.

From Lasagna L: The Hippocratic Oath: Modern Version, 1964. PBS website. Available at: http://www.pbs.org/wgbh/nova/doctors/oath_modern.html. Accessed January 28, 2010.

in their several relations to each other, to the medical profession, and to the public.

Additional components of the code address the need for reasonable remuneration for services and products, the need to distinguish between pure and impure drugs, the need to control the distribution of poisons, and the minimum requirements for education and apprenticeship.

The American Pharmacists Association (APhA), founded in 1852, modeled its first code of ethics after the Philadelphia College of Pharmacy code of ethics. Generally accepted as the professional guidelines for American pharmacists, the APhA code of ethics was revised in 1922, 1952, 1975, and 1994. The 1994 code of ethics (Box 10-4) differs significantly from earlier versions in that it provides principles based on "moral obligations and virtues" rather than practice-specific guidelines.[7] The 1994 code for the first time defines the pharmacist-patient relationship as a covenant, implying moral obligations such as compassion, caring, honesty, and integrity.[8]

The profession's ethical principles are further emphasized by the oath of the pharmacist (Box 10-5).[9] The oath is traditionally taken at the time of graduation from pharmacy school, but many pharmacy students take the oath as part of the "White Coat Ceremony" upon entry into the professional curriculum. The oath of the pharmacist states that the primary concern of the pharmacist is the welfare of humanity and relief of human suffering and that the pharmacist is expected to maintain the highest standards of moral, ethical, and legal conduct. The 2007 oath includes the expectation that pharmacists will respect and protect personal and health information and will help to prepare the next generation of pharmacists.

Box 10-4 Code of Ethics for Pharmacists

PREAMBLE

Pharmacists are health professionals who assist individuals in making the best use of medications. This Code, prepared and supported by pharmacists, is intended to state publicly the principles that form the fundamental basis of the roles and responsibilities of pharmacists. These principles, based on moral obligations and virtues, are established to guide pharmacists in relationships with patients, health professionals, and society.

PRINCIPLES

I. A pharmacist respects the covenantal relationship between the patient and the pharmacist.
II. A pharmacist promotes the good of every patient in a caring, compassionate, and confidential manner.
III. A pharmacist respects the autonomy and dignity of each patient.
IV. A pharmacist acts with honesty and integrity in professional relationships.
V. A pharmacist maintains professional competence.
VI. A pharmacist respects the values and abilities of colleagues and other health professionals.
VII. A pharmacist serves individual, community, and societal needs.
VIII. A pharmacist seeks justice in the distribution of health resources.

From American Pharmacists Association: Code of ethics for pharmacists. Washington, DC, 1994, The Association. Available at: http://www.pharmacist.com/AM/PrinterTemplate.cfm?Section=Code_of_Ethics_for_Pharmacists. Accessed January 28, 2010.

PHYSICIAN CODE OF ETHICS

The American Medical Association (AMA) established the first American medical code of ethics in 1847. The code was first revised in 1906 after several decades of discussion.[10] The current code, revised in 2001, describes the responsibilities of the physician to patients, society, other health care professionals, and self and establishes specific standards of conduct (Box 10-6).[11]

Box 10-5 Oath of a Pharmacist

I promise to devote myself to a lifetime of service to others through the profession of pharmacy. In fulfilling this vow:

- I will consider the welfare of humanity and relief of suffering my primary concerns.
- I will apply my knowledge, experience, and skills to the best of my ability to assure optimal outcomes for my patients.
- I will respect and protect all personal and health information entrusted to me.
- I will accept the lifelong obligation to improve my professional knowledge and competence.
- I will hold myself and my colleagues to the highest principles of our profession's moral, ethical and legal conduct.
- I will embrace and advocate changes that improve patient care.
- I will utilize my knowledge, skills, experiences, and values to prepare the next generation of pharmacists.

I take these vows voluntarily with the full realization of the responsibility with which I am entrusted by the public.

From American Pharmacists Association: Oath of a Pharmacist. Available at: http://www.pharmacist.com/AM/PrinterTemplate.cfm. Accessed January 28, 2010.

Box 10-6 American Medical Association Principles of Medical Ethics

PREAMBLE

The medical profession has long subscribed to a body of ethical statements developed primarily for the benefit of the patient. As a member of this profession, a physician must recognize responsibility to patients first and foremost, as well as to society, to other health professionals, and to self. The following Principles adapted by the American Medical Association are not laws, but standards of conduct which define the essentials of honorable behavior for the physician.

I. A physician shall be dedicated to providing competent medical service with compassion and respect for human dignity and rights.

II. A physician shall uphold the standards of professionalism, be honest in all professional interactions, and strive to report physicians deficient in character or competence, or engaging in fraud or deception, to appropriate entities.

III. A physician shall respect the law and also recognize a responsibility to seek changes in those requirements which are contrary to the best interests of the patient.

IV. A physician shall respect the rights of patients, of colleagues, and of other health professionals, and shall safeguard patient confidences within the constraints of the law.

V. A physician shall continue to study, apply and advance scientific knowledge, maintain a commitment to medical education, make relevant information available to patients, colleagues, and the public, obtain consultation, and use the talents of other health professionals when indicated.

VI. A physician shall, in the provision of appropriate patient care, except in emergencies, be free to choose whom to serve, with whom to associate, and the environment in which to provide medical services.

VII. A physician shall recognize a responsibility to participate in activities contributing to the improvement of the community and the betterment of public health.

VIII. A physician shall, while caring for a patient, regard responsibility to the patient as paramount.

IX. A physician shall support access to medical care for all people.

From American Medical Association: Principles of Medical Ethics. Available at: http://www.ama-assn.org/ama. Accessed January 28, 2010.

NURSING CODE OF ETHICS

The Florence Nightingale Pledge was adapted from the Hippocratic Oath in 1893 for the Farrand Training School for Nurses in Detroit, Michigan (Box 10-7).[12] The current Code of Ethics for Nurses (Box 10-8) describes the goals, values, and obligations of the nursing profession.[13]

Box 10-7 The Florence Nightingale Pledge

I solemnly pledge myself before God and in the presence of this assembly, to pass my life in purity and to practice my profession faithfully. I will abstain from whatever is deleterious and mischievous, and will not take or knowingly administer any harmful drug. I will do all in my power to maintain and elevate the standard of my profession, and will hold in confidence all personal matters committed to my keeping and all family affairs coming to my knowledge in the practice of my calling. With loyalty will I endeavor to aid the physician in his work, and devote myself to the welfare of those committed to my care.

From Florence Nightingale Pledge. American Nursing Association website. Available at: http://www.nursingworld.org. Accessed February 3, 1010.

PATIENTS' RIGHTS

Consumer Bill of Rights

President Clinton appointed the Advisory Commission on Consumer Protection and Quality in 1997 and charged the commission with developing a health care "consumer bill of rights" and providing recommendations for enforcing the rights. The commission's report is known as the *President's Patients' Bill of Rights* (Box 10-9).[14] The major goals of the Patients' Bill of Rights are to increase patient

Box 10-8 Code of Ethics for Nurses

1. The nurse, in all professional relationships, practices with compassion and respect for the inherent dignity, worth, and uniqueness of every individual, unrestricted by considerations of social or economic status, personal attributes, or the nature of health problems.
2. The nurse's primary commitment is to the patient, whether as individual, family, group, or community.
3. The nurse promotes, advocates for, and strives to protect the health, safety, and rights of the patient.
4. The nurse is responsible and accountable for individual nursing practice and determines the appropriate delegation of tasks consistent with the nurse's obligation to provide optimum patient care.
5. The nurse owes the same duties to self as to others, including the responsibility to preserve integrity and safety, to maintain competence, and to continue personal and professional growth.
6. The nurse participates in establishing, maintaining, and improving health care environments and conditions of employment conducive to the provision of quality health care and consistent with the values of the profession, through individual and collective action.
7. The nurse participates in the advancement of the profession through contributions to practice, education, administration, and knowledge development.
8. The nurse collaborates with other health professionals and the public in promoting community, national, and international efforts to meet health needs.
9. The profession of nursing, as represented by associations and their members, is responsible for articulating nursing values, for maintaining the integrity of the profession and its practice, and for shaping social policy.

From American Nursing Association: Code of Ethics for Nurses with Interpretive Statements. Available at: http://www.nursingworld.org/MainMenuCategories/EthicsStandards/CodeofEthicsforNurses. Accessed January 28, 2010.

Box 10-9 Patients' Bill of Rights

I. INFORMATION DISCLOSURE
Patients have the right to receive accurate, easily understood information to help them make informed decisions about their health plans, professionals and facilities.

II. CHOICE OF PROVIDERS AND PLANS
Consumers have the right to a choice of health care providers that is sufficient to ensure access to appropriate high-quality health care.

III. ACCESS TO EMERGENCY SERVICES
Consumers have the right to access emergency health care services when and where the need arises.

IV. PARTICIPATION IN TREATMENT DECISIONS
Consumers have the right and responsibility to fully participate in all decisions related to their health care.

V. RESPECT AND NONDISCRIMINATION
Consumers have the right to considerate, respectful care from all members of the health care system at all times and under all circumstances.

VI. CONFIDENTIALITY OF HEALTH INFORMATION
Consumers have the right to communicate with health care providers in confidence and to have the confidentiality of their individually identifiable health care information protected. Consumers also have the right to review and copy their own medical records and request amendments to their records.

VII. COMPLAINTS AND APPEALS
All consumers have the right to a fair and efficient process for resolving differences with the health plans, health care providers, and the institutions that serve them, including a rigorous system of internal review and an independent system of external review.

VIII. CONSUMER RESPONSIBILITIES
In a health care system that protects consumers' rights, it is reasonable to expect and encourage consumers to assume reasonable responsibilities. Greater individual involvement by consumers in their care increases the likelihood of achieving the best outcomes and helps support a quality improvement, cost-conscious environment.

You as a consumer can make a significant contribution in these key areas:

- Maximize healthy habits (e.g., exercising, not smoking, and eating a healthy diet).
- Become involved in care decisions.
- Work collaboratively with providers in developing and carrying out agreed-upon treatment plans.
- Disclose relevant information and clearly communicate wants and needs.
- Use the Federal Employment Health Benefits claims process when there is a disagreement between you and your health plan.
- Become knowledgeable about coverage and health plan options, including covered benefits, limitation and exclusions, rules regarding use of network providers, coverage and referral rules, appropriate processes to secure additional information, and process to appeal coverage decisions.
- Show respect for other patients and health workers.
- Make a good-faith effort to meet financial obligations.
- Report wrongdoing and fraud to appropriate resources or legal authorities.

From Patients' Bill of Rights. U.S. Office of Personnel Management website. Available at: http://www.opm.gov/insure/health/reference/billrights.asp. Accessed February 2, 2010.

confidence in the health care system, to emphasize the importance of the relationship between patients and their health care professionals, and to establish rights and responsibilities of patients and health care professionals. The Patients' Bill of Rights applies to federal employee insurance plans; many nonfederal insurance plans have voluntarily adopted the Patients' Bill of Rights.

The Patient Care Partnership

Patients have the ethical and legal right to make their own decisions regarding their health care. However, patients often lose their sense of autonomy when hospitalized and may not understand their rights as individuals. The American Hospital Association developed the Patient Care Partnership: Understanding Expectations, Rights, and Responsibilities, which describes institutional responsibilities to the patient and patient responsibilities (Box 10-10).[15]

Health Insurance Portability and Accountability Act of 1996

The Health Insurance Portability and Accountability Act (HIPAA), initially enacted in 1996 and modified in 2002, gives patients rights over their health information (oral, written, and electronic) and restricts access to patient

Box 10-10 The Patient Care Partnership: Understanding Expectations, Rights, and Responsibilities

When you need hospital care, your doctor and the nurses and other professionals at our hospital are committed to working with you and your family to meet your health care needs. Our dedicated doctors and staff serve the community in all its ethnic, religious, and economic diversity. Our goal is for you and your family to have the same care and attention we would want for our families and ourselves.

The sections below explain some of the basics about how you can expect to be treated during your hospital stay. They also cover what we will need from you to care for you better. If you have questions at any time, please ask them. Unasked or unanswered questions can add to the stress of being in the hospital. Your comfort and confidence in your care are very important to us.

WHAT TO EXPECT DURING YOUR HOSPITAL STAY

High Quality Care

Our first priority is to provide you the care you need, when you need it, with skill, compassion, and respect. Tell your caregivers if you have concerns about your care or if you have pain. You have the right to know the identity of doctors, nurses, and others involved in your care, as well as when they are students, residents, or other trainees.

A Clean and Safe Environment

Our hospital works hard to keep you safe. We use special policies and procedures to avoid mistakes in your care and keep you free from abuse or neglect. If anything unexpected and significant happens during your hospital stay, you will be told what happened and any resulting changes in your care will be discussed with you.

Involvement in Your Care

You and your doctor often make decisions about your care before you go to the hospital. Other times, especially in emergencies, those decisions are made during your hospital stay. When they take place, making decisions should include:

Discussing Your Medical Condition and Information about Medically Appropriate Treatment Choices

To make informed decisions with your doctor, you need to understand several things:

- The benefits and risks of each treatment.
- Whether it is experimental or part of a research study.
- What you can reasonably expect from your treatment and any long-term effects it might have on your quality of life.
- What you and your family will need to do after you leave the hospital.
- The financial consequences of using uncovered services or out-of-network providers.

Please tell your caregivers if you need more information about treatment choices.

Discussing Your Treatment Plan

When you enter the hospital, you sign a general consent to treatment. In some cases, such as surgery or experimental treatment, you may be asked to confirm in writing that you understand what is planned and agree to it. This process protects your right to consent to or refuse a treatment. Your doctor will explain the medical consequences of refusing recommended treatment. It also protects your right to decide if you want to participate in a research study.

Getting Information from You

Your caregivers need complete and correct information about your health and coverage so that they can make good decisions about your care.

That includes:

- Past illnesses, surgeries, or hospital stays.
- Past allergic reactions.
- Any medicines or diet supplements (such as vitamins and herbs) that you are taking.
- Any network or admission requirements under your health plan.

Understanding Your Health Care Goals and Values

You may have health care goals and values or spiritual beliefs that are important to your well-being. They will be taken into account as much as possible throughout your hospital stay. Make sure your doctor, your family, and your care team know your wishes.

Understanding Who Should Make Decisions When You Cannot

If you have signed a health care power of attorney stating who should speak for you if you become unable to make health care decisions for yourself, or a "living will" or "advance directive" that states your wishes about end-of-life care, give copies to your doctor, your family and your care team. If you or your family need help making difficult decisions, counselors, chaplains and others are available to help.

Box 10-10 The Patient Care Partnership: Understanding Expectations, Rights, and Responsibilities—cont'd

Protection of Your Privacy
We respect the confidentiality of your relationship with your doctor and other caregivers, and the sensitive information about your health and health care that are part of that relationship. State and federal laws and hospital operating policies protect the privacy of your medical information. You will receive a Notice of Privacy Practices that describes the ways that we use, disclose, and safeguard patient information and that explains how you can obtain a copy of information from our records about your care.

Help Preparing You and Your Family for When You Leave the Hospital
Your doctor works with hospital staff and professionals in your community. You and your family also play an important role. The success of your treatment often depends on your efforts to follow medication, diet, and therapy plans. Your family may need to help care for you at home.

You can expect us to help you identify sources of follow-up care and to let you know if your hospital has a financial interest in any referrals. As long as you agree we can share information about your care with them, we will coordinate our activities with your caregivers outside the hospital. You can also expect to receive information and, where possible, training about the self-care you will need when you go home.

Help with Your Bill and Filing Insurance Claims
Our staff will file claims for you with health care insurers or other programs such as Medicare and Medicaid. They will also help your doctor with needed documentation. Hospital bills and insurance coverage are often confusing. If you have questions about your bill, contact our business office. If you need help understanding your insurance coverage or health plan, start with your insurance company or health benefits manager. If you do not have health coverage, we will try to help you and your family find financial help or make other arrangements. We need your help with collecting needed information and other requirements to obtain coverage or assistance.

While you are here, you will receive more detailed notices about some of the rights you have as a hospital patient and how to exercise them. We are always interested in improving. If you have questions, comments, or concerns, please contact _____.

From American Hospital Association: The Patient Care Partnership: Understanding Expectations, Rights, and Responsibilities. Available at: http://www.aha.org. Accessed February 2, 2010.

information.[16] In addition to mandating that patient health information be protected, HIPAA gives patients the right to see and obtain a copy of their health records, correct errors in their health records, and decide if they want to give or deny permission to use or share their health information for reasons unrelated to their health (e.g., marketing). Health plans, health care providers (including pharmacists), and health care clearinghouses must follow the law. However, the law does not apply to some organizations and individuals, including employers, workers compensation carriers, life insurers, school districts, and law enforcement agencies.

ETHICAL ISSUES

Recent cases of unethical actions involving pharmacists and other health care professionals have received widespread publicity in the mainstream press as well as on the Internet. The case of Robert R. Courtney is a particularly notorious example of unethical behavior by a pharmacist entrusted with the lives of his patients. Courtney violated all four of the basic medical ethics principles (autonomy, beneficence, nonmaleficence, and justice) and took advantage of a particularly vulnerable patient population. In 2003, Courtney, labeled "the Toxic Pharmacist" by the *New York Times,* admitted watering down cancer chemotherapy drugs 158 times for 34 cancer patients and acknowledged that over a period of 9 years he diluted 72 different parenteral drugs for thousands of patients; personal profit was the apparent motive.[17] Wrongdoing was initially suspected in 1998 when an Eli Lilly sales representative thought that Courtney was selling more of Lily's Gemzar than he was buying from the company. The company investigated but could not identify another supplier. The Federal Bureau of Investigation and Food and Drug Administration (FDA) became involved after a physician, alerted to the issue, ordered some chemotherapy drugs, had the prepared dosages analyzed, and discovered the dilution. Courtney pleaded guilty to tampering and adulterating or misbranding Taxol and Gemzar and was sentenced to 17.5 to 30 years in federal prison. His pharmacist licenses were revoked, and he faced additional wrongful death litigation.

Some ethical issues (e.g., patient confidentiality) are well recognized and covered in universally accepted ethical guidelines. Some ethical issues (e.g., conscientious objection and the ethics of the relationship between the pharmaceutical industry and health care professionals) are relatively new with ethical guidelines under development. Other ethical issues (e.g., the role of the pharmacist in decision making regarding discontinuation of medical treatment) have only recently been identified; ethical guidelines may take years to develop.

CONSCIENTIOUS OBJECTION

Conscientious refusal of pharmacists to dispense valid prescriptions based on personal beliefs is a contemporary ethical issue that has received a lot of publicity over the last few years. Pharmacists are not required to dispense prescriptions if there is a question about the validity of the prescription. However, conscientious objection involves refusal to fill valid prescriptions (e.g., for oral contraceptives, abortifacients, antiretroviral medications, medications intended for use in assisted suicide)

or to stock and dispense behind-the-counter emergency contraceptives (e.g., levonorgestrel [Plan B, Plan B One-Step, Next Choice]) if the medication's use conflicts with the pharmacist's personal beliefs. The ethical conflict is between the rights of patients to access legally prescribed medications and the moral rights of pharmacists. In 2002 a Wisconsin pharmacist refused to refill or transfer a patient's Loestrin Fe 1/20 oral contraceptive prescription.[18] The patient, who ultimately did get her prescription refilled, was placed at risk of an unwanted pregnancy because the start of her next monthly contraceptive cycle was delayed by the delay in getting the refill. The pharmacist, who had previously notified his employer of his conscientious objection to filling prescriptions for oral contraceptives but had not objected to transferring prescriptions, was reprimanded by the Wisconsin State Board of Pharmacy for his unprofessional conduct.

In a 2004 editorial in the *New England Journal of Medicine,* Cantor and Baum state, "In a profession that is bound by fiduciary obligations and strives to respect and care for patients it is unacceptable to leave patients to fend for themselves. As a general rule, pharmacists who cannot or will not dispense a drug have an obligation to meet the needs of their customers by referring them elsewhere."[19]

Pharmacy professional organizations provide guidance regarding conscientious objection. The APhA's policy supports the right of pharmacists as well as the right of patient access[20]: "APhA recognizes the individual pharmacist's right to exercise conscientious refusal and supports the establishment of systems to ensure patient's access to legally prescribed therapy without compromising the pharmacist's right of conscientious refusal."

The policy of the American Society of Health-System Pharmacists (ASHP) also acknowledges the rights of pharmacists and the right of patient access.[21] The policy recognizes that pharmacists and other pharmacy employees have the right to "decline to participate in therapies they consider to be morally, religiously, or ethically troubling," but it also recognizes the obligation of the pharmacist to the patient by stating that a pharmacist exercising the right of conscience "must be respectful of, and serve the legitimate health care needs and desires of, the patient, and shall provide a referral without any actions to persuade, coerce, or otherwise impose on the patient the pharmacist's values, beliefs, or objections."

CONFIDENTIALITY

Confidentiality of patient information is a common ethical issue that all health care professionals address daily. The moral concept of confidentiality is present in many religious philosophies and was initially documented for the medical profession in the Hippocratic Oath. The Hippocratic Oath states, "What I may see or hear in the course of treatment or even outside of the treatment in regard to the life of men, which on no account one must spread abroad, I will keep to myself holding such things shameful to be spoken about."[2] Most health care professions provide guidelines regarding confidentiality of patient information.

Confidentiality of patient information is maintained not only out of respect for the basic moral right of the patient to privacy but also to encourage patients to entrust pharmacists with the details of their illnesses and use of medications. An environment must be created which assures patients that information discussed with the pharmacist will be used only by those involved in their care. Few patients would be willing to admit to nonadherence to prescribed medication regimens or would discuss illicit drug use if they thought the information would become public.

To uphold patient confidentiality, access to written and computerized patient records, including medication histories and patient monitoring records, must be restricted to individuals providing patient care. Patient records should not be used for drug promotion, identification of patients who could be switched from one branded product to another, or other for-profit endeavors. Patient cases should not be discussed in public areas such as hallways, elevators, and cafeterias. Discussions with patients and discussions about specific patient cases should be held in private settings, such as consultation rooms, conference rooms, or other private areas.

RESEARCH ETHICS

Research is an important activity for many pharmacists; pharmacists often serve as principal investigators or co-investigators. Other research-related responsibilities include protocol development; grant writing; and administrative tasks, such as obtaining institutional approval for research, enrolling subjects, obtaining informed consent, dispensing agents, ensuring inventory control, collecting data, analyzing data, and reporting results.

The need for universally accepted ethical standards evolved as types and numbers of research protocols increased. Historical misconduct added to the need for universal ethical standards. For example, research in the mid-twentieth century often was conducted on prisoners, mentally incompetent persons, and patients in insane asylums; little consideration was given to the ethics of such research or the rights of the participants, who were often viewed as less than human.[22] Nazis' abuse of prisoners during World War II led to the development of the Nuremberg code, an internationally recognized research code of ethics (Box 10-11).[23] The World Medical Association's Declaration of Helsinki, derived from the Nuremberg Code, is a widely accepted international code of research ethics (Box 10-12).[24]

In addition to complying with internationally accepted research codes of ethics, pharmacists must comply with federal regulations regarding the rights of research subjects. The federal regulations consist of the Department of Health and Human Services (DHSS) *Code of Federal Regulations* (CFR) Title 45A, part 46, and Title 21 of the FDA.[25] These regulations describe the composition and function of institutional review boards (IRBs), define the elements of informed consent, and provide the guidelines for documentation of informed consent.

The purpose of an IRB, also known as a *human research review board* (HRRB) or *human investigation committee* (HIC), is to safeguard the rights and welfare of human research subjects. Investigators must submit all research protocols to the board and obtain approval before performing the

Box 10-11 The Nuremberg Code

The great weight of evidence before us is to the effect that certain types of medical experiments on human beings, when kept within reasonably well-defined bounds, conform to the ethics of the medical profession generally. The protagonists of the practice of human experimentation justify their views on the basis that such experiments yield results for the good of society that are unprocurable by other methods or means of study. All agree, however, that certain basic principles must be observed in order to satisfy moral, ethical, and legal concepts.

1. The voluntary consent of the human subject is absolutely essential.
2. The experiment should be such as to yield fruitful results for the good of society, unprocurable by other methods or means of study, and not random and unnecessary in nature.
3. The experiment should be so designed and based on the results of animal experimentation and a knowledge of the natural history of the disease or other problem under study that the anticipated results will justify the performance of the experiment.
4. The experiment should be so conducted as to avoid all unnecessary physical and mental suffering and injury.
5. No experiment should be conducted where there is an a priori reason to believe that death or disabling injury will occur; except, perhaps, in those experiments where the experimental physicians also serve as subjects.
6. The degree of risk to be taken should never exceed that determined by the humanitarian importance of the problem to be solved by the experiment.
7. Proper preparations should be made and adequate facilities provided to protect the experimental subject against even remote possibilities of injury, disability, or death.
8. The experiment should be conducted only by scientifically qualified persons. The highest degree of skill and care should be required through all stages of the experiment of those who conduct or engage in the experiment.
9. During the course of the experiment the human subject should be at liberty to bring the experiment to an end if he has reached the physical or mental state where continuation of the experiment seems to him to be impossible.
10. During the course of the experiment the scientist in charge must be prepared to terminate the experiment at any stage, if he has probably [sic] cause to believe, in the exercise of the good faith, superior skills and careful judgment required of him, that a continuation of the experiment is likely to result in injury, disability, or death to the experimental subject.

From *Trials of war criminals before the Nuremberg military tribunals under control council law* 10:181-182, October 1946-April 1949.

Box 10-12 The Declaration of Helsinki

A. INTRODUCTION

1. The World Medical Association (WMA) has developed the Declaration of Helsinki as a statement of ethical principles for medical research involving human subjects, including research on identifiable human material and data. The Declaration is intended to be read as a whole and each of its constituent paragraphs should not be applied without consideration of all other relevant paragraphs.
2. Although the Declaration is addressed primarily to physicians, the WMA encourages other participants in medical research involving human subjects to adopt these principles.
3. It is the duty of the physician to promote and safeguard the health of patients, including those who are involved in medical research. The physician's knowledge and conscience are dedicated to the fulfillment of this duty.
4. The Declaration of Geneva of the World Medical Association binds the physician with the words, "The health of my patient will be my first consideration," and the International Code of Medical Ethics declares that, "A physician shall act only in the patient's interest when providing medical care."
5. Medical progress is based on research that ultimately must include studies involving human subjects. Populations that are underrepresented in medical research should be provided appropriate access to participation in research.
6. In medical research involving human subjects, the well-being of the individual research subject must take precedence over all other interests.
7. The primary purpose of medical research involving human subjects is to understand the causes, development and effects of diseases and improve preventive, diagnostic and therapeutic interventions (methods, procedures and treatments). Even the best current interventions must be evaluated continually through research for their safety, effectiveness, efficiency, accessibility and quality.
8. In medical practice and in medical research, most interventions involve risks and burdens.
9. Medical research is subject to ethical standards that promote respect for all human subjects and protect their health and rights. Some research populations are particularly vulnerable and need special protection. These include those who cannot give or refuse consent for themselves and those who may be vulnerable to coercion or undue influence.
10. Physicians should consider the ethical, legal and regulatory norms and standards for research involving human subjects in their own countries as well as applicable international norms and standards. No national or international ethical, legal or regulatory requirement should reduce or eliminate any of the protections for research subjects set forth in this declaration.

Continued

Box 10-12 The Declaration of Helsinki—cont'd

B. BASIC PRINCIPLES FOR ALL MEDICAL RESEARCH

11. It is the duty of physicians who participate in medical research to protect the life, health, dignity, integrity, right to self-determination, privacy, and confidentiality of personal information of research subjects.
12. Medical research involving human subjects must conform to generally accepted scientific principles, [and] be based on a thorough knowledge of the scientific literature, other relevant sources of information, and adequate laboratory and, as appropriate, animal experimentation. The welfare of animals used for research must be respected.
13. Appropriate caution must be exercised in the conduct of medical research that may harm the environment.
14. The design and performance of each research study involving human subjects must be clearly described in a research protocol. The protocol should contain a statement of the ethical considerations involved and should indicate how the principles in this Declaration have been addressed. The protocol should include information regarding funding, sponsors, institutional affiliations, other potential conflicts of interest, incentives for subjects and provisions for treating and/or compensating subjects who are harmed as a consequence of participation in the research study. The protocol should describe arrangements for post study access by study subjects to interventions identified as beneficial in the study or access to other appropriate care or benefits.
15. The research protocol must be submitted for consideration, comment, guidance and approval to a research ethics committee before the study begins. This committee must be independent of the researcher, the sponsor and any other undue influence. It must take into consideration the laws and regulations of the country or countries in which the research is to be performed as well as applicable international norms and standards, but these must not be allowed to reduce or eliminate any of the protections for research subjects set forth in this Declaration. The committee must have the right to monitor ongoing studies. The researcher must provide monitoring information to the committee, especially information about any serious adverse events. No change to the protocol may be made without consideration and approval by the committee.
16. Medical research involving human subjects must be conducted only by individuals with the appropriate scientific training and qualifications. Research on patients or healthy volunteers requires the supervision of a competent and appropriately qualified physician or other health care professional. The responsibility for the protection of research subjects must always rest with the physician or other health care professional and never the research subjects, even though they have given consent.
17. Medical research involving a disadvantaged or vulnerable population or community is only justified if the research is responsive to the health needs and priorities of this population or community and if there is a reasonable likelihood that this population or community stands to benefit from the results of the research.
18. Every medical research study involving human subjects must be preceded by careful assessment of the predictable risks and burdens to the individuals and communities involved in the research in comparison with foreseeable benefits to them and to other individuals or communities affected by the condition under investigation.
19. Every clinical trial must be registered in a publicly accessible database before recruitment of the first subject.
20. Physicians may not participate in a research study involving human subjects unless they are confident that the risks involved have been adequately assessed and can be satisfactorily managed. Physicians must immediately stop a study when the risks are found to outweigh the potential benefits or when there is conclusive proof of positive and beneficial results.
21. Medical research involving human subjects may only be conducted if the importance of the objectives outweighs the inherent risks and burdens to the research subjects.
22. Participation by competent individuals as subjects in medical research must be voluntary. Although it may be appropriate to consult family members or community leaders, no competent individual may be enrolled in a research study unless he or she freely agrees.
23. Every precaution must be taken to protect the privacy of research subjects and the confidentiality of the personal information and to minimize the impact of the study on their physical, mental and social integrity.
24. In medical research involving competent human subjects, each potential subject must be adequately informed of the aims, methods, sources of funding, any possible conflicts of interest, institutional affiliations of the researcher, the anticipated benefits and potential risks of the study and the discomfort it may entail, and any other relevant aspects of the study. The potential subject must be informed of the right to refuse to participate in the study or to withdraw consent to participate at any time without reprisal. Special attention should be given to the specific information needs of individual potential subjects as well as to the methods used to deliver the information. After ensuring that the potential subject has understood the information, the physician or another appropriately qualified individual must then seek the potential subject's freely-given informed consent, preferably in writing. If the consent cannot be expressed in writing, the non-written consent must be formally documented and witnessed.
25. For medical research using identifiable human material or data, physicians must normally seek consent for the collection, analysis, storage and/or reuse. There may be situations where consent would be impossible or impractical to obtain for such research or would pose a threat to the validity of the research. In such situations the research may be done only after consideration and approval of a research ethics committee.

Box 10-12 The Declaration of Helsinki—cont'd

26. When seeking informed consent for participation in a research study, the physician should be particularly cautious if the potential subject is in a dependent relationship with the physician or may consent under duress. In such situations the informed consent should be sought by an appropriately qualified individual who is completely independent of this relationship.
27. For a potential research subject who is incompetent, the physician must seek informed consent from the legally authorized representative. These individuals must not be included in a research study that has no likelihood of benefit for them unless it is intended to promote the health of the population represented by the potential subject, the research cannot instead be performed with competent persons, and the research entails only minimal risk and minimal burden.
28. When a potential research subject who is deemed incompetent is able to give assent to decisions about participation in research, the physician must seek that assent in addition to the consent of the legally authorized representative.
29. Research involving subjects who are physically or mentally incapable of giving consent, for example, unconscious patients, may be done only if the physical or mental condition that prevents giving informed consent is a necessary characteristic of the research population. In such circumstances the physician should seek informed consent from the legally authorized representative. If no such representative is available and if the research cannot be delayed, the study may proceed without informed consent provided that the specific reasons for involving subjects with a condition that renders them unable to give informed consent have been stated in the research protocol and the study has been approved by a research ethics committee. Consent to remain in the research should be obtained as soon as possible from the subject or a legally authorized representative.
30. Authors, editors and publishers all have ethical obligations with regard to the publication of the result of research. Authors have a duty to make publicly available the results of their research on human subjects and are accountable for the completeness and accuracy of their reports. They should adhere to accepted guidelines for ethical reporting. Negative and inconclusive as well as positive results should be published or otherwise made publicly available. Sources of funding, institutional affiliations and conflicts of interest should be declared in the publication. Reports of research not in accordance with the principles of this Declaration should not be accepted for publication.

C. ADDITIONAL PRINCIPLES FOR MEDICAL RESEARCH COMBINED WITH MEDICAL CARE

31. The physician may combine medical research with medical care only to the extent that the research is justified by its potential preventive, diagnostic or therapeutic value and if the physician has a good reason to believe that participation in the research study will not adversely affect the health of the patients who serve as research subjects.
32. The benefits, risks, burdens and effectiveness of a new intervention must be tested against those of the best current proven intervention, except in the following circumstances:
    The use of placebo, or no treatment, is acceptable in studies where no current proven intervention exists; or
    Where for compelling and scientifically sound methodological reason the use of placebo is necessary to determine the efficacy or safety of an intervention and the patients who receive placebo or no treatment will not be subject to any risk of serious or irreversible harm. Extreme care must be taken to avoid abuse of this option.
33. At the conclusion of the study, patients entered into the study are entitled to be informed about the outcome of the study and to share any benefits that result from it, for example, access to interventions identified as beneficial in the study or to other appropriate care or benefits.
34. The physician must fully inform the patient which aspects of the care are related to the research. The refusal of a patient to participate in a study or the patient's decision to withdraw from the study must never interfere with the patient-physician relationship.
35. In the treatment of a patient, where proven interventions do not exist or have been ineffective, the physician, after seeking expert advice, with informed consent from the patient or a legally authorized representative, may use an unproven intervention if in the physician's judgment it offers hope of saving life, re-establishing health or alleviating suffering. Where possible, this intervention should be made the object of research, designed to evaluate its safety and efficacy. In all cases, new information should be recorded and, where appropriate, made publicly available.

Adopted by the 18th WMA General Assembly, Helsinki, Finland, June 1964, and amended by the
29th WMA General Assembly, Tokyo, Japan, October 1975
35th WMA General Assembly, Venice, Italy, October 1983
41st WMA General Assembly, Hong Kong, September 1989
48th WMA General Assembly, Somerset West, Republic of South Africa, October 1996
52nd WMA General Assembly, Edinburgh, Scotland, October 2000
53rd WMA General Assembly, Washington 2002 (Note of Clarification on paragraph 29 added)
55th WMA General Assembly, Tokyo 2004 (Note of Clarification on paragraph 30 added)
59th WMA General Assembly, Seoul, October 2008

From World Medical Association: WMA Declaration of Helsinki—Ethical Principles for Medical Research Involving Human Subjects. Available at: http://wma.net/en/30publications/10policies/b3/index.html. Accessed January 28, 2010.

Box 10-13 Elements of Informed Consent

BASIC ELEMENTS OF INFORMED CONSENT

1. A statement that the study involves research
2. An explanation of the purposes of the research
3. The expected duration of the subject's participation in the study
4. A description of the procedures to be followed
5. Identification of experimental procedures
6. A description of reasonably foreseeable risks or discomforts to the subject
7. A description of any benefits to the subject or to others
8. Disclosure of alternative procedures or courses of treatment
9. A statement describing the extent to which confidentiality will be maintained and noting that the Food and Drug Administration may see the subject's record
10. A statement on the availability of medical treatments and compensation in case the subject is injured by participation in the study
11. Whom to contact for answers to questions about the research and subject's rights
12. Whom to contact in the event a research-related injury occurs
13. A noncoercive disclaimer that participation is voluntary, refusal to participate involves no penalty or loss of benefits, and the subject may discontinue participation at any time without penalty or loss of benefits

OPTIONAL ELEMENTS

1. A statement that the treatment or procedure may involve risks to the subject (or embryo or fetus, if the subject is or becomes pregnant) which are currently unforeseeable
2. Circumstances under which the subject's participation may be terminated by the investigator without the subject's consent
3. Additional costs to the subject from participating in the research
4. Consequences of a subject's decision to withdraw from the research and procedures for orderly termination of participation by the subject
5. A statement that significant new findings during the course of research that may relate to the subject's willingness to continue to participate will be given to the subject
6. The approximate number of subjects in the study

From *Code of federal regulations,* Title 21—Food and Drugs. Chapter 1—Food and Drug Administration. Department of Health and Human Services. Subchapter A—General. Part 50—Protection of Human Subjects. U.S. Food and Drug Administration website. Available at: http://www.accessdata.fda/gov/scripts/cdrh/dfdocs/cfcfr/CFRSearch.crfm. Accessed January 28, 2010.

research. Each institution in which human research is conducted must have this type of board. Noninstitutional HRRBs are available for researchers engaged in clinical research who are not affiliated with a specific institution.

The composition of research review boards is defined by the FDA. Each board must be composed of at least five members with varying backgrounds capable of reviewing the types of research proposals submitted to the board. Board membership also must be diverse. The board cannot be composed of all men, all women, or members of just one profession. At least one board member must be a nonscientist such as a lawyer, ethicist, or member of the clergy, and at least one member must not otherwise be associated with the institution sponsoring the board.

Approval of research proposals is based on decisions regarding the relative risk to subjects, subject identification and selection, consent procedures and documentation, and method of ensuring subject confidentiality. Research subjects must be informed in order to uphold the ethical principle of self-determination. Although the primary purpose of the board is to protect the rights of subjects, the board may comment on study design issues and the scientific merit of proposals.

A primary focus of the board is the content of the consent form and the way in which consent is obtained and documented. Written informed consent is required for most human research; for some relatively low-risk protocols consent may be obtained verbally. For consent to be valid, it must be voluntary. The written information must be expressed in lay terms. Exculpatory language cannot be used, and subjects must be legally competent. Federal regulations define required and additional elements of informed consent. Consent forms must contain certain specified elements; other elements are optional (Box 10-13).

ETHICS AND THE PROMOTION OF PRESCRIPTION DRUGS

Health care professionals question the ethics of accepting gifts from drug companies.[26-28] Gifts ranging from low-cost items such as pens, notepads, clothing, textbooks, and meals to high-cost gifts such as all-expense-paid trips to luxury resorts and cash gifts used to be common. Pharmacists attending national pharmacy association meetings often attended industry-sponsored continuing education presentations, receptions, and parties and collected bags of gifts from pharmaceutical industry exhibitors.

The ethical issues are complex and grow out of the unique relationship between the pharmaceutical industry and health care professionals. Unlike other types of advertising, pharmaceutical advertising targets health care professionals, who influence drug selection, and not patients, the ultimate consumers of the products. Acceptance of these gifts carries ethical implications, no matter the monetary value of the gift.

The ethical implications of accepting gifts from the pharmaceutical industry involve issues of justness and obligations.[29] The cost of pharmaceutical gifts and other forms of advertising is included in the price of medications. Therefore some argue that spending patients' money without their knowledge or consent and without direct benefit is unjust. Gift giving also implies obligations on the part of the recipient. The obligations may be subtle, but even the appearance of an obligation may alter society's trust in the profession.

Box 10-14 American College of Clinical Pharmacy's Guidelines for Ethical Interactions with Industry

- Patient welfare should be the pharmacist's primary concern.
- Pharmacists should not accept gifts that influence or appear to influence objectivity, independence, or fairness.
- Pharmacists should disclose industry relationships that have or appear to have a conflict of interest.
- Pharmacists with decision-making authority should avoid relationships with industry that have or appear to have a conflict of interest.
- Pharmacists who are members of an institutional review board should avoid relationships with industry that have or appear to have a conflict of interest.
- Pharmacists should only participate in industry-sponsored research if the research meets accepted ethical, regulatory and scientific standards.
- Pharmacists should only author publications that meet accepted ethical, regulatory and scientific standards.
- Pharmacists participating in continuing education programs should be fair and unbiased.
- Formal professional ethics instruction should be incorporated into college of pharmacy and postgraduate pharmacy training programs.
- Patient confidentiality should be maintained for all industry interactions.

From Pharmacists and industry: guidelines for ethical considerations. *Pharmacotherapy* 28:410-420, 2008.

Guidelines regarding the relationships between health care professionals and the pharmaceutical industry continue to evolve. Although most of the discussions have targeted physicians, the ethical issues, and therefore the guidelines, are applicable to other health care professionals. In 1992 the ASHP board of directors approved and published the ASHP guidelines on pharmacists' relationships with industry.[29] The guidelines address the issues of gifts and hospitality, continuing education, consultancies and advisory arrangements, clinical research, and disclosure of information. The 2008 guidelines of the American College of Clinical Pharmacy (ACCP) expand the original 2003 guidelines for ethical interactions with the pharmaceutical industry to all industry sectors (Box 10-14).[30]

Guidelines regarding the relationships between the pharmaceutical industry and health professionals also are evolving. The Pharmaceutical Research and Manufacturers of America (PhRMA) first adopted a voluntary Code on Interactions with Healthcare Professionals in 2002; an updated and enhanced code became effective January 1, 2009.[31] The code addresses the interactions between pharmaceutical and biotechnology companies and health care professionals, including industry-sponsored informational presentations, educational meetings, consultancy arrangements, and the use of non–patient-identified prescriber data. Common practices of the past, such as sponsoring dinner at a local restaurant, paying for gasoline or a round of golf at a local golf club, or giving gifts such as golf balls or mugs imprinted with a drug name, are no longer acceptable. The code allows companies to offer gifts that are primarily for patient education (e.g., anatomic models, educational posters) if the gift is not of substantial value ($100 or less) and does not have value beyond the health care professional's professional responsibilities. Companies can provide modest meals with presentations if the presentation is at the health care professional's office or hospital.

ADVANCE DIRECTIVES

Advance directives are written legal documents that give a patient the ability to influence future treatment decisions should the patient lose the ability to make decisions. Advance directives are the focus of the Patient Self-Determination Act (PSDA), a law that went into effect on December 1, 1991.[32] The intent of the PSDA is to promote the knowledge and use of advance directives. The law, which applies to all health care institutions that receive Medicare or Medicaid funds (hospitals, nursing facilities, hospices, home care programs, and health maintenance organizations), requires institutions to give all individuals receiving medical care written information about their rights under state law to make decisions about their care, including the right to accept or refuse medical or surgical care. Individuals also must be given information about their rights to formulate advance directives. Institutions must prepare policies consistent with state law, document in each individual's medical record whether the individual has executed an advance directive, and develop public education programs.

The two main types of advance directive are living wills[33] (Box 10-15) and durable powers of attorney[34] (Box 10-16); some hybrid documents combine elements of each. A living will provides direction regarding specific medical treatments the person does or does not want at the end of life and can serve as a general reference for decision making. The advantage of living wills is that individuals can identify specific interventions, such as surgery, dialysis, chest compression, and intubation and mechanical ventilation, that they do not want. Living wills are especially useful for patients with chronic illnesses. However, living wills require that individuals predict future acceptable and unacceptable medical interventions, often without an accurate or complete understanding of all available options or the implications of each option. Living wills do not appoint an alternate decision maker and often must be interpreted when difficult decisions must be made regarding end-of-life treatment.

Written durable powers of attorney appoint an alternate decision maker (the proxy) who is legally empowered to make decisions regarding the care of the patient. A durable power of attorney is activated whenever the patient is incapacitated. The advantage of the durable power of attorney is that an individual can identify a person to engage in future discussions regarding specific clinical situations. However, the durable power of attorney does not by itself tell the proxy what decisions to make on the patient's behalf. The scope of proxy responsibilities varies by state statue, but the proxy is generally empowered to admit the person to an acute or chronic

Box 10-15 Example of a Living Will

To my doctor:

While I have been at _____, I have discussed my wishes concerning my medical treatment in the event that I become extremely ill. I did this in the hope that if I made my wishes known beforehand, it would be easier for my doctors to know my preferences at a time when I am unable to express them.

If I become critically ill:
I want to be hospitalized.
I want to go into intensive care.
I want to have my heart revived if my heart stops.
I want to have surgery.
I want to be put on a breathing machine.

If I become terminally ill:
I want to be hospitalized.
I want my family members to decide whether I shall go into intensive care after they talk with my doctor.
I want my doctor to decide whether to revive me if my heart stops.
I want my family members to decide whether I shall have surgery after they talk with my doctor.
I want my family members to decide whether I shall be put on a breathing machine after they talk with my doctor.

If I am in an irreversible coma:
I want to be hospitalized.
I want my family members to decide whether I shall go into intensive care after they talk with my doctor.
I want my doctor to decide whether to revive me if my heart stops.
I want my family members to decide whether I shall have surgery after they talk with my doctor.
I do not want to be put on a breathing machine.
I want my family members to decide whether I shall be fed through a tube after they talk with my doctor.

If I am unable to make decisions for myself, I would like the following person to make necessary decisions on my behalf:

1. Name (relationship)
Address
Phone: (home)
(work)

If you cannot reach _____, I would like the following person to make the necessary decisions on my behalf:

2. Name (relationship)
Address
Phone: (home)
(work)

There will be a time when I want my doctor to stop keeping me alive.

I have provided this information in the hope that it will be easier to respect my wishes about my medical care at a time when I am unable to express them.

Patient name _____ _____ _____
(printed) (signature) (date)

Witness name _____ _____ _____
(printed) (signature) (date)

From Danis M, Southerland LI, Garrett JM, et al: A prospective study of advance directives for life-sustaining care. *N Engl J Med* 324:882-888, 1991.

care facility and to arrange for and consent to medical and surgical treatment.

One of the most common problems associated with advance directives is that the document may not be available when decisions have to be made. The document may be locked in a safe deposit box, filed in a lawyer's office, or held by distant offspring. Another problem is that the document may be out of date and may not accurately reflect the patient's desires as the patient faces the realities of end-of-life illnesses and gains experience with available technology and other interventions. Pharmacists should be aware of the presence of advance directives and ensure that therapeutic decisions are made in accordance with the patient's wishes.

WITHHOLDING AND WITHDRAWING MEDICAL INTERVENTIONS

Withholding of life support and withdrawal of life support refer to decisions to withhold or withdraw medical interventions with the expectation that the patient will die from the change in support. Technologic and pharmaceutical advances provide health care professionals with effective tools for prolonging life. At issue, however, are the quality of life and the right of patients to make their own decisions. Competent patients or alternate decision makers have the right to choose. Health care professionals have the ethical responsibility to inform patients and alternate decision makers of their choices and to honor their decisions. Although the responsibility for withholding or withdrawing life support rests with the patient or proxy and the patients' physician, broad consensus is sought among all health professionals involved in the care of the patient. Every effort is made to honor the patient's wishes regarding these difficult decisions.

APPLICATION ACTIVITIES

Discuss the following questions and issues. The activities are best performed by discussing the issues in groups of two or three people but may be completed individually.

1. What do the modern Hippocratic Oath, the Oath of a Pharmacist, and the Florence Nightingale Pledge have in common?
2. A researcher would like to use blood samples left over from several previous studies to look for potential links between drug metabolism and exploratory genetic biomarkers. The subjects in the previous research studies only consented to the use of their blood for the monitoring of potential adverse drug reactions to the

Box 10-16 Example of a Durable Power of Attorney

I, _____
(principal—print your name)
residing at
_____
(street) (city or town) (state)
Appoint as my Health Care Agent
_____
(name of person you choose as agent)
of _____
(street) (city or town) (state)

Optional: If my agent is unwilling or unable to serve, then I appoint as my alternate
_____
(name of person you choose as alternate)
of _____
(street) (city or town) (state)

My agent shall have the authority to make all health care decisions for me, subject to any limitations I state below, if I am unable to make decisions myself. My agent's authority becomes effective if my attending physician determines in writing that I lack the capacity to make or to communicate health care decisions. My agent is then to have the same authority to make health care decisions as I would if I had the capacity to make them, except (here list the limitations, *if any,* you wish to place on your agent's authority):

Signed_____

Complete only if principal is physically unable to sign: I have signed the principal's name above at his or her direction in the presence of the principal and two witnesses.

_____
(name)
_____
(street)
_____
(city or town) (state)

WITNESS STATEMENT

We, the undersigned, each witnessed the signing of this Health Care Proxy by the principal or at the direction of the principal and state that the principal appears to be at least 18 years of age, of sound mind, and under no constraint or undue influence. Neither of us is named as the health care agent or alternate in this document.

In our presence this _____ day of _____ 20 _____.
Witness 1_____ Witness 2 _____
Name (print) _____ Name (print) _____
Address _____ Address _____
_____ _____

From Annas GJ: The health care proxy and the living will. *N Engl J Med* 324:1210-1213, 1991.

investigational drugs used in those studies. None of the subjects in the studies gave consent for any future use of his or her leftover blood. According to the World Medical Association's Declaration of Helsinki, what must the researcher do to use the leftover blood for the new study?

3. Discuss the professional pharmacy guidelines for dealing with each of the following situations:
   a. A pharmacist refuses to fill prescriptions for oral contraceptives or dispense emergency contraception.
   b. A pharmaceutical company representative invites a pharmacist who is a member of the institution's Pharmacy and Therapeutics Committee (a committee that makes final decisions regarding formulary drug additions and deletions) to a week-long, all-expense-paid trip for two to a Florida resort. The pharmacist is expected to attend educational programs about the company's new antibiotic and provide an opinion about the new antibiotic.
   c. A patient asks the pharmacist to fill a prescription for an opioid narcotic. The pharmacist verifies that the prescription is valid but notes that the patient has had three similar prescriptions written by different physicians filled in the last 10 days.

SELF-ASSESSMENT QUESTIONS

1. Which of the following is the fundamental moral principle on which all ethical behavior is based?
   a. Do good and avoid evil
   b. Do what is best for society as a whole
   c. Obey all federal laws
   d. Maintain patient confidentiality
   e. Obey all state laws
2. What do the pharmacy, nursing, and medical codes of ethics have in common?
   a. Hippocrates wrote all three codes.
   b. All contain issue-specific guidelines.
   c. All are based on the Declaration of Helsinki.
   d. All were written in the sixth century BC.
   e. All provide broad-based directives.
3. The Patient Care Partnership was created to do which of the following?
   a. Protect institutions from lawsuits
   b. Advise hospitalized patients of their rights
   c. Prevent patients from making bad decisions
   d. Give autonomy to alternate decision makers
   e. Advise ambulatory patients of their rights

4. According to the Patient Care Partnership, what should patients expect when they are hospitalized?
   a. High-quality care
   b. Protection of privacy
   c. A clean and safe environment
   d. All of the above
   e. None of the above
5. Which of the following actions violate(s) patient confidentiality?
   a. Discussing a patient case in a public elevator
   b. Disclosing the results of diagnostics tests to friends of the patient
   c. Allowing public access to electronically stored patient information
   d. All of the above
   e. a and c above
6. What is wrong with a research review board composed of four male physicians?
   a. A board must have at least five members.
   b. More than one profession must be represented.
   c. Both men and women must be members.
   d. All of the above
   e. None of the above
7. The primary purpose of an IRB is to do which of the following?
   a. Judge the scientific merit of proposed research
   b. Locate funding sources for proposed research
   c. Safeguard the rights and welfare of human subjects
   d. Analyze the results of studies
   e. Protect the rights of researchers
8. Which of the following is an optional element of informed consent?
   a. Information on additional costs to the subject for participating in the study
   b. An estimate of the expected duration of the subject's participation in the study
   c. A disclosure of alternatives to participating in the study
   d. Information on whom to contact for answers to questions about the research subject's rights
   e. A statement that participation in the study is voluntary
9. Accepting gifts from the pharmaceutical industry involves which of the following ethical principles?
   a. Justness
   b. Obligation
   c. Respect
   d. a and b above
   e. None of the above
10. Which of the following statements regarding living wills is false?
    a. Living wills provide specific information regarding medical treatment the patient does or does not want to have at the end of life.
    b. Living wills often must be interpreted.
    c. Living wills appoint a health care proxy.
    d. Living wills may become outdated.
    e. Living wills provide patients with the means to influence future treatment decisions.
11. Which of the following statements regarding the durable power of attorney is true?
    a. The durable power of attorney appoints a proxy who makes decisions on behalf of the patient.
    b. The durable power of attorney is activated at the time of signing.
    c. The durable power of attorney tells the proxy exactly what to do on behalf of the patient.
    d. The scope of responsibilities of individuals holding durable power of attorney is the same in all states.
    e. The durable power of attorney empowers the proxy to admit the patient to an acute care facility but not a chronic care facility.
12. Which of the following is a common problem with advance directives?
    a. They may not reflect the patient's current desires.
    b. They may be locked in a safe deposit box.
    c. They may be held by a distant relative.
    d. All of the above
    e. None of the above

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Audio glossary terms

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Appendix: Acronyms by Chapter

CHAPTER 1

AANP	American Academy of Nurse Practitioners
AAPA	American Academy of Physician Assistants
ABMS	American Board of Medical Specialties
ACCP	American College of Clinical Pharmacy
ACPE	American Council on Pharmaceutical Education
ADN	Associate degree in nursing
AE-C	Certified Asthma Educator
APhA	American Pharmacists Association
AQ	Added Qualifications
ASHP	American Society of Health-System Pharmacists
BCNP	Board Certified Nuclear Pharmacist
BCNSP	Board Certified Nutrition Support Pharmacist
BCOP	Board Certified Oncology Pharmacist
BCPP	Board Certified Psychiatric Pharmacist
BCPS	Board Certified Pharmacotherapy Specialist
BPS	Board of Pharmaceutical Specialties
BSN	Bachelor of science in nursing
CACP	Certified Anticoagulation Care Provider
CCP	Council on Credentialing in Pharmacy
CCRN	Certified Critical Care Registered Nurse
CDE	Certified Diabetic Educator
CEU	Continuing education unit
CLS	Clinical Lipid Specialist
CME	Continuing medical education
CPP	Credentialed Pain Practitioner
DABAT	Diplomate of the American Board of Applied Toxicology
DNP	Doctor of Nursing Practice
DO	Doctor of Osteopathy
DSME	Diabetes self-management education
EMR	Electronic medical record
FFS	Fee for service
FPGEC	Foreign Pharmacy Graduate Examination Committee
HIV	Human immunodeficiency virus
HMO	Health maintenance organization
JAR	Junior admitting resident
MAP	Medication action plan
MD	Medical doctor
MOC	Maintenance of certification
MPJE	Multi-State Pharmacy Jurisprudence Examination
MTM	Medication therapy management
NAPLEX	North American Pharmacist Licensure Examination
NP	Nurse practitioner
OTC	Over the counter
PA	Physician assistant
PA-C	Physician Assistant–Certified
PCP	Primary care physician
PGY-1, PG1	First postgraduate year
PGY-2, PG2	Second postgraduate year
PGY-3, PG3	Third postgraduate year
PMR	Personal medication record
POMR	Problem-oriented medical record
POS	Point of service
PPO	Preferred provider organization
RN	Registered nurse
SAR	Senior admitting resident
USMLE	United States Medical Licensing Examination

CHAPTER 2

ASL	American Sign Language
EHR	Electronic health record
EMR	Electronic medical record
ESFT	Explanatory, social, fears, treatment
HIPAA	Health Insurance Portability and Accountability Act of 1996
IATV	Two-way interactive television
OTC	Over-the-counter
SOAP	Subjective, Objective, Assessment, Plan

CHAPTER 3

CDC	Centers for Disease Control and Prevention
DOB	Date of birth
NPSG	National Patient Safety Goal (Joint Commission)
pk-yr	Pack-year
ppd	Packs per day
prn	As needed; on demand
SOAP	Subjective, Objective, Assessment, Plan
tid	Three times daily
WM	White male

CHAPTER 4

2ICS LSB	Second intercostal space left sternal border
2ICS RSB	Second intercostal space right sternal border
5ICS MCL	Fifth intercostal space midclavicular line
A&P	Auscultation and percussion
ADL	Activities of daily living
AV	Atrioventricular
BMI	Body mass index
COPD	Chronic obstructive pulmonary disease
CTA	Clear to auscultation
DBP	Diastolic blood pressure
HDL-C	High-density lipoprotein cholesterol
IPPA	Inspection, percussion, palpation, auscultation
JNC 7	Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure
JVP	Jugular venous pressure
LDL-C	Low-density lipoprotein cholesterol
LLSB	Left lower sternal border
LLL	Left lower lobe
LUL	Left upper lobe
MMSE	Mini-Mental State Examination
NCAT	Normal cephalic atraumatic
Pap smear	Papanicolaou smear
PMI	Point of maximal impulse
RLL	Right lower lobe
RML	Right middle lobe
RRR	Regular rhythm and rate
RUL	Right upper lobe
S_1	First heart sound
S_2	Second heart sound
S_3	Third heart sound
S_4	Fourth heart sound
SBP	Systolic blood pressure
WHR	Waist/hip ratio

CHAPTER 5

ABG	Arterial blood gas
ABO	Blood group system (A, B, O and AB)
ACTH	Adrenocorticotropic hormone
AD	Alzheimer's disease
ADH	Antidiuretic hormone
AIDS	Acquired immunodeficiency syndrome
ALL	Acute lymphoblastic leukemia
ALT	Alanine aminotransferase
AMC	Arm muscle circumference
AMI	Acute myocardial infarction
ANA	Antinuclear antibody
ANCA	Antineutrophil cytoplasmic antibody
ANP	Atrial natriuretic peptide
aPTT	Activated partial thromboplastin time
ASO	Antistreptolysin-O
AST	Aspartate aminotransferase
AV	Aortic valve
aVF	Augmented voltage, left foot
aVR	Augmented voltage, right arm
aVL	Augmented voltage, left arm
BCR/ABL	Breakpoint cluster region/Abelson
BE	Base excess
BNP	Brain natriuretic peptide
BQRT	Biomarker qualification review team
BUN	Blood urea nitrogen
CA125	Cancer antigen 125
CA19-9	Cancer antigen 19-9
c-ANCA	Cytoplasmic antineutrophil cytoplasmic antibody
C3	Complement C3
C4	Complement C4
CBC	Complete blood count
CC	Chief complaint
CCR-5	Chemokine C-C motif receptor
CD4	Helper T lymphocyte antigenic marker
CD8	Helper T lymphocyte antigenic marker
CEA	Carcinoembryonic antigen
CH_{50}	Total hemolytic complement
CK	Creatine kinase
CK1 (CK-BB)	Creatine kinase BB fraction (found primarily in the brain)
CK2 (CK-MB)	Creatine kinase MB fraction (found primarily in the heart)
CK3 (CK-MM)	Creatine kinase MM fraction (found primarily in the skeletal muscle)
CK-BB (CK1)	Creatine kinase BB fraction (found primarily in the brain)
CK-MB (CK2)	Creatine kinase MB fraction (found primarily in the heart)
CK-MM (CK3)	Creatine kinase MM fraction (found primarily in the skeletal muscle)
CO_2	Carbon dioxide
CRP	C-reactive protein
CSF	Cerebrospinal fluid
CT	Computed tomography
CYP2C9	Cytochrome P-450 enzyme 2C9
DLCO	Carbon monoxide diffusion capacity
DNA	Deoxyribonucleic acid
DSA	Digital subtraction angiography
dsDNA	Double-stranded deoxyribonucleic acid
EC	External carotid artery
ECG	Electrocardiogram
EEG	Electroencephalography
EGD	Esophagogastroduodenoscopy
EGFR	Epidermal growth factor receptor
EMG	Electromyography
ENA	Extractable nuclear antigen
EPS	Electrophysiologic study

ERCP	Endoscopic retrograde cholangiopancreatography
ESR	Erythrocyte sedimentation rate
FDA	Food and Drug Administration
FDP	Fibrin degradation products
FEV_1	Forced expiratory volume in 1 second
FT_4I	Free thyroxine index
FVC	Forced vital capacity
GGT	Gamma glutamyl transpeptidase
G6PD	Glucose-6-phosphate dehydrogenase
GTT	Glucose tolerance test
HDL	High-density lipoprotein
HER2/NEU	v-*erb* erythroblastic leukemia viral oncogene homologue 2
HIV	Human immunodeficiency virus
HLA	Human leukocyte antigen
IC	Internal carotid artery
IND	Investigational new drug
INR	International normalized ratio
ISI	International sensitivity index
iTreg	Induced regulatory helper T cell
Kim1	Kidney injury molecule 1
KOH	Potassium hydroxide
IgE	Immunoglobulin E
IgG	Immunoglobulin G
IgM	Immunoglobulin M
IL-6	Interleukin-6
IL-18	Interleukin-18
IVP	Intravenous pyelography
KUB	Kidney, ureter, bowel
LA	Left atrium
LDH	Lactate dehydrogenase
LDL	Low-density lipoprotein
LV	Left ventricle
MBC	Minimum bactericidal concentration
MCH	Mean cell hemoglobin
MCHC	Mean cell hemoglobin concentration
MCV	Mean cell volume
MIC	Minimum inhibitory concentration
MRI	Magnetic resonance imaging
MUAC	Middle upper arm circumference
MUGA	Multiple gated acquisition
MV	Mitral valve
NC	Negative control
NDA	New drug application
NGAL	Neutrophil gelatinase–associated lipocalin
NIH	National Institutes of Health
P	Plasma
Paco2	Partial pressure of carbon dioxide in arterial blood
Pao2	Partial pressure of oxygen in arterial blood
p-ANCA	Perinuclear antineutrophil cytoplasmic antibody
PC	Positive control
PCT	Procalcitonin
PEF	Peak expiratory flow
PEFR	Peak expiratory flow rate
PET	Positron-emission tomography
PSA	Prostate-specific antigen
PT	Prothrombin time
PTH	Parathyroid hormone
RA	Right atrium
RAIU	Radioactive iodine uptake
RBC	Red blood cell
RDW	Red cell distribution width
RF	Rheumatoid factor
RNA	Ribonucleic acid

RNP	Ribonucleic protein
RPR	Rapid plasma reagin
RV	Residual volume; right ventricle
S	Serum
Sao_2	Arterial oxygen saturation
SCD40	Soluble CD40
SIADH	Syndrome of inappropriate antidiuretic hormone secretion
SLE	Systemic lupus erythematosus
Sm	Smith antigen
SPECT	Single-photon emission computed tomography
SPEP	Serum protein electrophoresis
SS-A/Ro	Sjögren's syndrome A nuclear antigen
SS-B/La	Sjögren's syndrome B nuclear antigen
Scl-70	Scleroderma-70 antigen
ssDNA	Single-stranded deoxyribonucleic acid
T_3	Triiodothyronine
T_3U	Triiodothyronine uptake
T_4	Thyroxine
TDP	Torsades des pointes
TEE	Transesophageal echocardiography
TG	Triglyceride
Th1	Helper T lymphocyte, type 1
Th2	Helper T lymphocyte, type 2
Th17	Helper T lymphocyte, type 17
TIBC	Total iron-binding capacity
TNF	Tumor necrosis factor
TOF	Train-of-four
TPMT	Thiopurine 5-methyltransferase
TRH	Thyrotropin-releasing hormone
TSH	Thyroid-stimulating hormone
TTE	Transthoracic echocardiography
TV	Tidal volume
U	Urine
UGT1A1	Uridine diphosphate glucuronosyltransferase 1A1
VDRL	Venereal Disease Research Laboratory
VKORC1	Vitamin K epoxide reductase complex, subunit 1
VLDL	Very-low-density lipoprotein
VMA	Vanillylmandelic acid
$\dot{V}/\dot{Q}$	Ventilation/perfusion
WB	Whole blood
WBC	White blood cell

CHAPTER 6

AAM	African American male
ABG	Arterial blood gas
AC	Before meals
ALT	Alanine aminotransferase
A&O×3	Alert and oriented to person, place, and time
AP	Anteroposterior
A&P	Auscultation and percussion
ASA	Aspirin
AST	Aspartate aminotransferase
AV	Arteriovenous
A&W	Alive and well
B	Brother
BID	Twice daily
B/L	Bilateral
BP	Blood pressure
BS	Blood sugar
BUN	Blood urea nitrogen

CABG	Coronary artery bypass graft
CAD	Coronary artery disease
CBC	Complete blood count
CC	Chief complaint
CCE	Cyanosis, clubbing, and edema
C/D	Cup/disc ratio
CKD	Chronic kidney disease
CN II-XII	Cranial nerves 2 through 12
c/o	Complained of
COPD	Chronic obstructive pulmonary disease
CP	Chest pain
Cr	Creatinine
CTAP	Clear to auscultation and percussion
CV	Cardiovascular
CXR	Chest radiograph
DM	Diabetes mellitus
DOB	Date of birth
DOE	Dyspnea on exertion
ECG	Electrocardiogram
ED	Emergency department
EOMI	Extraocular movements intact
F	Father
FEV_1	Forced expiratory volume in 1 second
FH	Family history
F_IO_2	Fraction of inspired oxygen
FROM	Full range of motion
FVC	Forced vital capacity
GF	Grandfather
GM	Grandmother
gtt	Drop
HCT	Hematocrit
Hb	Hemoglobin
HDL	High-density lipoprotein
HEENT	Head, eyes, ears, nose, and throat
HM	Hispanic male
HPI	History of present illness
HR	Heart rate
Hs	Bedtime
HTN	Hypertension
5ICS	Fifth intercostal space
6ICS	Sixth intercostal space
JVD	Jugular venous distention
L	Left
LDL	Low-density lipoprotein
LE	Lower extremities
LFT	Liver function test
M	Mother
MCL	Midclavicular line
MedHx	Medication history
MI	Myocardial infarction
m/r/g	Murmurs, rubs, and gallops
NABS	Normal active bowel sounds
NAD	No apparent distress
NCAT	Normocephalic atraumatic
Neuro	Neurologic system
NTND	Nontender, nondistended
OU	Both eyes
$Paco_2$	Partial pressure of carbon dioxide in arterial blood
Pao_2	Partial pressure of oxygen in arterial blood
PCN	Penicillin
PE	Physical examination
PEF	Peak expiratory flow
PERRLA	Pupils equal, round, and reactive to light and accommodation

PLTS	Platelets
PMH	Past medical history
PMI	Point of maximal impulse
ppd	Packs per day
R	Right
RIME	Reporter, interpreter, manager, and educator
ROS	Review of systems
RR	Respiratory rate
RRR	Regular rate and rhythm
S	Sister
S_1	First heart sound
S_2	Second heart sound
S_3	Third heart sound
S_4	Fourth heart sound
Sao_2	Oxygen saturation in arterial blood
SH	Social history
SMA-6	Simultaneous multichannel autoanalyzer-6 (sodium, potassium, chloride, carbon dioxide content, blood urea nitrogen, creatinine)
SOB	Shortness of breath
S/P	Status post (history of)
T	Temperature
TM	Tympanic membrane
WDWN	Well developed, well nourished
UA	Urinalysis
UE	Upper extremities
WBC	White blood cells
WM	White male
WNL	Within normal limits
XR	Extended release
y/o	Year-old
yr	Year

CHAPTER 7

A&O×3	Awake and oriented to person, place, and time
A&P	Auscultation and percussion
A&W	Alive and well
BMI	Body mass index
BP	Blood pressure
C	Celsius
CBC	Complete blood count
CC	Chief complaint
CTAP	Clear to auscultation and percussion
CV	Cardiovascular
DM	Diabetes mellitus
DNA	Deoxyribonucleic acid
eGFR	Estimated glomerular filtration rate
EOMI	Extraocular muscles intact
F	Father; female; Fahrenheit
FH	Family history
GERD	Gastroesophageal reflux disease
Hb A_{1C}	Glycosylated hemoglobin
HEENT	Head, eyes, ears, nose, and throat
HPI	History of present illness
HR	Heart rate
HTN	Hypertension
LE	Lower extremities
M	Mother
m/r/g	Murmurs, rubs, and gallops
NABS	Normal active bowel sounds
NCAT	Normocephalic atraumatic

Neuro	Neurologic system
NKDA	No known drug allergies
NTND	Nontender nondistended
PERRLA	Pupils equal, round, and reactive to light and accommodation
PMH	Past medical history
PMI 5ICS MCL	Point of maximal impulse at the fifth intercostal space and midclavicular line
ROS	Review of systems
RR	Respiratory rate
RRR	Regular rate and rhythm
RUQ	Right upper quadrant
S_1	First heart sound
S_2	Second heart sound
SAR	Seasonal allergic rhinitis
SOAP	Subjective, Objective, Assessment, Plan
SH	Social history
S/P	Status post (history of)
T	Temperature
TM	Tympanic membrane
UE	Upper extremities
Wk	Week
WNL	Within normal limits
y/o	Year old
yr	Year

CHAPTER 8

ABG	Arterial blood gas
ALT	Alanine aminotransferase
AP	Alkaline phosphatase
AST	Aspartate aminotransferase
BP	Blood pressure
BUN	Blood urea nitrogen
C	Celsius
C_aO_2	Oxygen content, arterial
CO_2 content	Carbon dioxide content
CPK	Creatine phosphokinase
CV	Cardiovascular
C_vO_2	Oxygen content, venous
CXR	Chest radiograph
DBP	Diastolic blood pressure
DOE	Dyspnea on exertion
ECG	Electrocardiogram
ESR	Erythrocyte sedimentation rate
F	Fahrenheit
FDA	Food and Drug Administration
FEV_1	Forced expiratory volume in 1 second
F_IO_2	Fraction of inspired oxygen
Hb A_{1C}	Glycosylated hemoglobin
HR	Heart rate
INR	International normalized ratio
Lb	Pound
LDH	Lactate dehydrogenase
MAP	Mean arterial pressure
MRI	Magnetic resonance imaging
MTM	Medication therapeutic management
P_aCO_2	Partial pressure of carbon dioxide in arterial blood
P_aO_2	Partial pressure of oxygen in arterial blood
PAOP mean	Pulmonary artery occlusion pressure, mean
PAP mean	Pulmonary artery pressure, mean
PAP diastolic	Pulmonary artery pressure, diastolic
PAP systolic	Pulmonary artery pressure, systolic

PDA	Personal digital assistant
PMN	Polymorphonuclear leukocyte
PT	Prothrombin time
PTT	Partial thromboplastin time
PRN	As needed
PVR	Pulmonary vascular resistance
RAP	Right atrial pressure
RVP	Right ventricular pressure
RVP diastolic	Right ventricular pressure, diastolic
RVP systolic	Right ventricular pressure, systolic
RBC	Red blood cell
S_aO_2	Oxygen saturation in arterial blood
SBP	Systolic blood pressure
SOAP	*S*ubjective, *O*bjective, *A*ssessment, *P*lan
SOB	Shortness of breath
SVR	Systemic vascular resistance
T	Temperature
VPD	Ventricular premature depolarization
WBC	White blood cell

CHAPTER 9

AHFS	American Hospital Formulary Service
aVL	Augmented voltage, left arm
aVR	Augmented voltage, right arm
BRS	Bibliographic Retrieval Services
CBER	Center for Biologics Evaluation and Research
CDER	Center for Drug Evaluation and Research
COS	Community of Science
FDA	Food and Drug Administration
HON	Health on the Net Foundation
HSV	Herpes simplex virus
IPA	International Pharmaceutical Abstracts
JCR	Journal Citation Reports
JIF	Journal impact factor
MeSH	Medical Subject Headings (of the National Library of Medicine)
NDC	National Drug Code
NLM	National Library of Medicine
PDA	Personal digital assistant

CHAPTER 10

ACCP	American College of Clinical Pharmacy
AMA	American Medical Association
APhA	American Pharmacists Association
ASHP	American Society of Health-System Pharmacists
CFR	*Code of Federal Regulations*
DHSS	Department of Health and Human Services
FDA	Food and Drug Administration
HIC	Human investigation committee
HIPAA	Health Insurance Portability and Accountability Act of 1996
HRRB	Human research review board
IRB	Institutional review board
PhRMA	Pharmaceutical Research and Manufacturers of America
PSDA	Patient Self-Determination Act
WM	World Medical Association

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